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A Better Life with Bionics

BOOK OF THE MONTH

GM Food, Anxieties and Expectations

Title	:	Jenithaka Bhakshanam: Aasankakalum Pratheekshakalum (In Malayalam)
Author	:	N. S. Arun Kumar
Pages	:	138
Publisher	:	DC Books
ISBN	:	978-81-264-2914-1
Price	:	80/-

The latter part of the 20th century witnessed the emergence of two new powerful branches of technology, namely Information Technology and Biotechnology. Towards the end of the 20th century both these technologies have influenced human life in many ways. Information Technology has influenced almost all fields of activities of mankind and has now become an inseparable and essential part of human knowledge base. Biotechnology on the other hand helped man to understand the origin of life on this planet and has provided answers to many of the mysteries that puzzled mankind for generations, such as origin of species, transfer of parental traits to offsprings etc. Since Biotechnological innovations are directly linked to living organisms, particularly life and living forms, many of the biotechnological discoveries have been the subject of debate on moral, ethical, religious, social, political and health grounds.

The book 'GM food, anxieties and expectations' by Shri N.S. Arun Kumar is an impassionate attempt to present the arguments for and against GM foods. The author has been successful in presenting the book to the general public in a simple and lucid manner. In the chapter on 'Genetic changes, history and science', he has been successful in presenting the growth and development of Genetics beginning from the early work of Gregor Mendel with latter part of the 19th century to the latest development of Genetically Modified Organisms (GMOs).

In the chapter on 'The agricultural advantages of genetic crops', the author gives very useful information on various GM crops and an account of countries which cultivate GM crops. Further the beneficial use of cultivating GM crops that can resist insects, parasites and viruses are described in a simple and lucid manner. The genesis and production of Bt crops is explained in simple language. Development of GM crops with controlled ripening, flavour savour tomatoes etc. are also discussed in this chapter. In subsequent chapters the author gives detailed accounts of Genetically Modified foods, the impact of GM crops on environment, the legal control of Genetic products, Genetic research and future expectations.

The book, written in Malayalam, is published by DC Books, Kottayam, Kerala in January, 2011. The author is to be congratulated for selecting a topic which has been a subject of debate in diverse fora concerning the moral, ethical, political, environmental and safety aspects. The book is written in a simple, lucid and comprehensive manner and is extremely useful to students of science and the lay public. With immense pleasure, I recommend the book to the Malayalam reading public in general and I recommend that the book should be translated in to English for a wider access.

Dr. P. Pushpangadan
(Padma Shri Awardee)
Director General
Amity Institute for Herbal and Biotech Products Development (AIHBPD) &
Senior Vice President, RBEF
3-Ravi Nagar,
Peroorkada P.O, Thiruvananthapuram – 695 005
E mail: palpurakulam@yahoo.co.in

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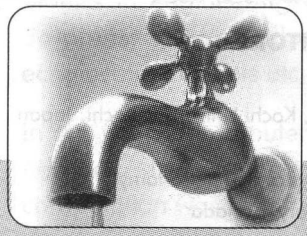

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SCIENCE INDIA
Sastra Bhavan, B4, 4th Floor, Mather Square
Town Railway Station Road, Kochi - 682 018
Ph: 0484 - 2393242, 2393256 Fax: 2393256
E-mail: scienceindia2010@gmail.com
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Editorial

Bionics (also known as biomimicry, biomimetics, bio-inspiration, biognosis, and close to bionical creativity engineering) is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology. It was popularized by the 1970s television series The Six Million Dollar Man and The Bionic Woman, which were influenced by Steele's work, and feature humans given superhuman powers by electromechanical implants.

The transfer of technology between life forms and manufactures is, according to proponents of bionic technology, desirable because evolutionary pressure typically forces living organisms, including fauna and flora, to become highly optimized and efficient. A classical example is the development of dirt- and water-repellent paint (coating) from the observation that the surface of the lotus flower plant is practically unsticky for anything (the lotus effect).

The term "biomimetic" is preferred when reference is made to chemical reactions. In that domain, biomimetic chemistry refers to reactions that, in nature, involve biological macromolecules (for example, enzymes or nucleic acids) whose chemistry can be replicated using much smaller molecules *in vitro*. Examples of bionics in engineering include the hulls of boats imitating the thick skin of dolphins; sonar, radar, and medical ultrasound imaging imitating the echolocation of bats etc.

In the field of computer science, the study of bionics has produced artificial neurons, artificial neural networks, and swarm intelligence. Evolutionary computation was also motivated by bionics ideas but it took the idea further by simulating evolution in silico and producing well-optimized solutions that had never appeared in nature.

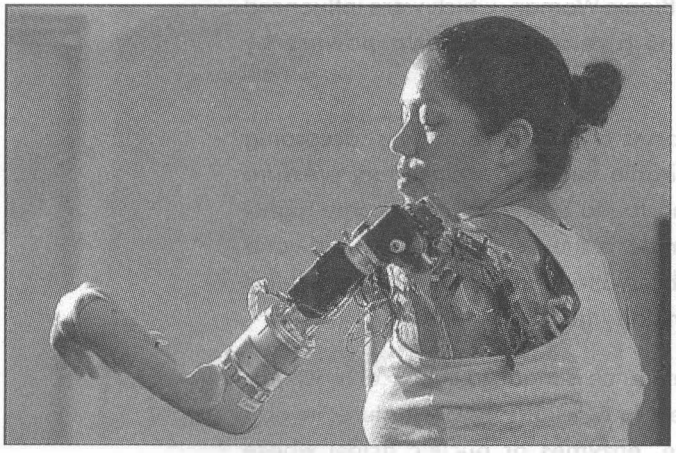
The Cover Story of this issue of Science India is "A better life with bionics". Another interesting article on "Robots in the farm" introduces some of the robots used in agriculture.

Team Science India

A Better Life with Bionics

Dr. S.S. Verma

Great strides of technology in areas like transportation, communication, medical, energy, biotechnology and bionics have really improved our way of living, if it is put to proper use of human beings. The word bionics was coined by Jack E. Steele in



1958, possibly originating from the Greek word βιον, bíon, pronounced [bi:on] ("bee-on"), meaning 'unit of life' and the suffix -ic, meaning 'like' or 'in the manner of', hence 'like life'. Some dictionaries, however, explain the word as being formed as a portmanteau from 'bio'logy + electronics'

Bionics is thus distinct from bioengineering (or biotechnology), which is the use of living things to perform certain industrial tasks. Bionics (also known as biomimicry, biomimetics, bio-inspiration, biognosis, and close to bionical creativity engineering) is the application of biological methods and systems found in nature to the study and design of engineering systems and modern technology to make it useful to human beings in need. Bionics is an interscience field of science and engineering of constructing artificial systems that have some of the characteristics of living systems. The science of designing, constructing, evaluating, and maintaining artificial systems that imitate living systems is called bionics. Bionics make use of models of living systems, in order to find new ideas for useful artificial machines and body systems to make technological engineering systems useful for human beings those who need them. Bionicists analyze the structural and functional principles of organ systems in living things and then use those principles to build useful artificial systems and machines.

It was popularized later on by science fiction works featuring humans given superhuman powers by electromechanical implants. The transfer of technology between life forms and manufactures is, according to proponents of bionic technology, desirable because evolutionary pressure typically forces living organisms, including fauna and flora, to become highly optimized and efficient. A classical example is the development of dirt- and water-repellent paint (coating) from the observation that the surface of the lotus flower plant is practically unsticky for anything. Examples of bionics in engineering include the hulls of boats

imitating the thick skin of dolphins; sonar, radar, medical ultrasound imaging imitating the echolocation of bats, and artificial limbs controlled by human thought etc. Recent prosthesis research has shown that the medical fantasies of yesteryear might just be the realities of today. In the field of computer science, the study of bionics has produced artificial neurons, artificial neural networks, and swarm intelligence. With advances in computer science, the technology used to create bionic limbs is a combination of artificial neurons and neural systems. Evolutionary computation was also motivated by bionics ideas but it took the idea further by simulating evolution in silico and producing well-optimized solutions that had never appeared in nature.

Bionic limbs

Conventional prosthetic limbs are problematic because they can do only one movement at any particular moment. However, bionic limb allows rotating, bending, opening and closing in some instances simultaneously. Today, bionics has progressed to an amazing level and has truly improved the lives of many people. For bionics to the aid of human beings with the help of bionic limbs it is rightly said that

"If you were able to do it before and you have the desire and the will to do it again, then the technology is there and we can make it happen..." - Brooks Raney

We are living in a technological new world, one that brings hope to those who through birth or by accident have lost function to parts of their body. Not only in defense forces people suffer from loss of limbs but this can happen anywhere to anyone as a result of accidents and illnesses, thus making the life of the person miserable. Today, bionics has progressed to an amazing level and has truly improved the lives of many people. The procedure involves grafting shoulder nerves to the pectoral muscle. The grafts receive thought-generated impulses, and the activity is sensed by electrodes within the muscle. The electrodes relay the signals to the arm's computer, which causes motors to move the elbow and hand. Hence, when amputee thinks "Close hand," electrical signals sent through surgically re-routed nerves make it happen. Moreover, unlike typical artificial arms, there is no perceivable delay in motion.

Most of the functions of our body are driven by electrical currents from a part of our brain called the motor cortex. The motor cortex sends out the electrical impulses down the spinal cord through nerves into our muscles. These electrical impulses cause our muscles to move, raise and lower our arm, walk or run and a multitude of other seemingly simple movements we take for granted each day. Brain-Machine Interfaces replicate this system, and is what makes bionics possible. Bionic limbs carry onboard artificial intelligences that help amputees use their bionic limbs with security and accuracy. Not only do the limbs move in a natural way and provide the strength to climb stairs foot over foot, they learn the user's gait. Overtime, the bionic limbs will know how you walk better than you do.

Developments

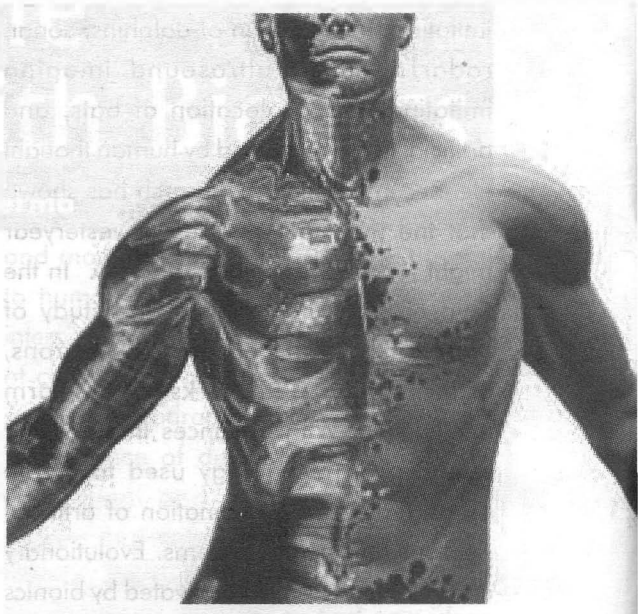
- Bionic limb breakthrough made by scientists have developed technology

that enables artificial limbs to be directly attached to a human skeleton. The work paves the way for bionic limbs which are controlled by the central nervous system. The technique, called *Intraosseous Transcutaneous Amputation Prosthesis* (ITAP), involves securing a titanium rod directly into the bone; the metal implant passes through the skin and the artificial limb can be directly attached to it. This differs from current prosthesis, where the artificial limbs are fixed or strapped to an amputee's stump. ITAP reduces the chances of infection because the skin tissue meshes around the rod to form a seal against bacteria.

- Alongside the bionic limb, progress is being made in both restoring sight to the blind and hearing to the deaf. Sight is being restored *via*. a small camera mounted in the patient's glasses feeding the image to an electronic chip. This is implanted on the retina of the eye.
- Hearing is being restored by a cochlear implant where tiny wires are inserted to the cochlea and a microphone fixed to the skull.
- As scientists work to link machine and mind, bionic limbs are gaining many of the capabilities of human ones.

The future of bionics

The success of procedures of bionic limbs performed on patients has prompted numerous organizations to support bionic research. The biomedical industry can expect to see a big advance in technology in the next few years as the governments



have allocated huge funds to develop artificial limbs. Some other bionic projects currently in development are an artificial retina that may be used to restore sight to the blind, and *Brain Gate*, a programme that decodes brain waves and translates them into computer commands. One of the next great challenges for bionic limbs is to make them "feel", creating the ability for the limb to send information back to the brain. Creating a sense of touch, hot and cold as well as being sensitive to the amount of pressure being applied. Thanks to the staggering technological advances being made in the field of prosthesis, future amputees walking or running down the street will move with the same ease as everybody else. Now that's science fiction worth believing.

Dr. S.S. Verma
Department of Physics
S.L.I.E.T.
Longowal
Sangrur Dist.
Punjab -148 106
E Mail: ssverma@fastmail.fm

ROBOTS IN THE FARM

G.S. Unnikrishnan Nair

The idea of applying robotics technology in agriculture is very new. The agricultural industry is behind other industries in using robots because the sort of jobs involved in agriculture are not straight forward and many repetitive tasks are not exactly the same every time. In most cases, a lot of factors have to be considered before the commencement of a task. Following are some of the robots used in agriculture now.

The Oracle Robot

The Oracle Robot is a sheep-shearing robot and it was developed at the University of Western Australia in 1979. Many of the Oracle's concepts formed the basis for its successor, the Shear Magic Robot.

During shearing operations, the sheep is restrained firmly by holding its legs and its head in a manipulator, called the 'ARAMP'. The shearing arm is directed by complex motion control algorithms, which maintain the cutter at a predefined height above the sheep's skin. It should be noted that not all sheep are of the same shape, and they sometimes object very strongly to being shorn.

The robotics arm, which 'holds' the clippers, can be maneuvered in six directions, and is powered by a series of hydraulic actuators using proportional analogue servo controls. These actuators are controlled by a minicomputer through a conventional D/A interface. The Hewlett Packard 21MX-E is utilized to control Oracle.

In order to maintain such a critical distance from the sheep's' skin, many 'Sensors' are used. These give feedback regarding the actual position of the shearing arm and the relative position of the sheep's' skin. Difficulties are associated with such sensing, as wool has a tendency to conduct electricity, and this characteristic can vary with moisture, humidity and other environmental factors, so sensors can give erroneous readings. However, a combination of several types of sensors is used to keep the clippers at a safe distance from the skin whilst still ensuring a reliable cut to the wool.

The Oracle Robot uses a software model of the surface of a sheep in order to have a preliminary 'idea' of the task ahead, and to determine an approach route to the sheep. When the robot is within a pre-determined distance from the sheep, the sensor inputs take over. The cutter follows a surface path computed from weight and dimension data for the sheep to be shorn. This path is then modified by a minicomputer depending on data received from the various sensors. The surface model is predicted on the basis of statistical

correlation with a large 'sheep database'. Further to this concept, the Oracle can 'learn' from each sheep shorn, by using the actual surface encountered and the predicted surface to obtain an error, which is then taken into account for the next animal.

The Shear Magic Robot

The Shear Magic Robot was developed to improve on the Oracle Robot. Oracle proved that robotics sheep shearing was a feasible operation, but proved to be a little too cumbersome to implement on the sheep stations when coupled with the ARAMP manipulator. The Shear Magic Robot was designed to be more compact and practical unit based on what was learned from the Oracle system. Advances in computer engineering meant that more computer power could be called upon to assist the Shear Magic Robot in its task, and enabled the Shear Magic's designers to build a better sheep shearer.

The Shear Magic Robot operates from above the animal rather than from the side as the Oracle system did. This allows the robot to have access to more surface area without moving the animal and improves the workspace size considerably. Having the robot overhead means that the floor space can be used for animal and wool handling equipment, and all impurities drops away from the robot rather than around it. Aside from this basic difference, the Shear Magic Robot retains the same surface modeling techniques used by the Oracle, but has a more extensive sensor suite and more effective control logic due to developments in technology since Oracle's day.

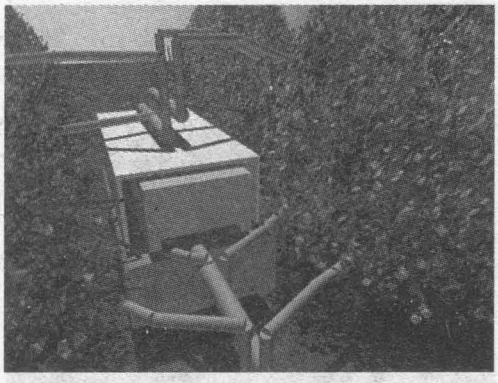
Overall, the Shear Magic Robot was regarded as a system, which is suitable for an automated sheep-shearing production line. The robots may be mounted on overhead rails, allowing them to be mobile throughout the plant. When one manipulator is loading or unloading an animal, the robot may move to another section to assist or begin shearing another animal. This is possible with a centralized control system. The Shear Magic Robot uses the Simplified Loading and Manipulation Platform, which is a derivative of the ARAMP system used in the Oracle Robot.

Fruit Picking Robot

The fruit picking robot is becoming a boon to Australia's orchards. Considering the size of the Australian agricultural market, which provides products to 17 million Australians and people from the rest of the world, the robot's efficiency advantage is really useful in the farms. Farm duties are time consuming, involving long hours for teams of pickers, who are usually university students on vacation or backpackers. Robotics system can increase the productivity of an orchard immensely, as it can pick the right fruit every time once calibrated, eliminating any wastage.

The principles of fruit picking robots have been developed since the early 1980's. These principles have opened up new approaches to the harvesting of crops. However, to fully develop the fruit picking robotics technology, contributions from high-tech industry, agricultural commodity groups and farm equipment manufacturers must be sought.

To start with, the fruit picking robots need to pick ripe fruit without damaging the



branches or leaves of the tree. Mobility is a priority, and the robots must be able to access all areas of the tree being harvested. It goes then without saying that the robots must be 'intelligent', and have a human-like interaction with their surroundings through senses of touch, sight, and image processing.

These robots can distinguish between fruit and leaves by using video image capturing. The camera is mounted on the robot arm, and the colors detected are compared with properties stored in memory. If a match is obtained, the fruit is picked. If leaves hide fruit, an air jet can be used to blow leaves out the way so a clearer view and access can be obtained. The robot arm itself is coated in rubber to minimize any damage to the tree. It has 5 degrees of freedom, allowing it to move, in, out, up, down, and in cylindrical and spherical motion patterns. The pressure applied to the fruit is sufficient for removal from the tree, but not enough to crush the fruit. A feedback process from the gripper mechanism, which is driven by motors, hydraulics, or a pneumatic system, accomplishes this. The shape of the gripper depends on the fruit being picked, as some fruits, such as plums, crush very easily, while others, like oranges are not so susceptible to bruising.

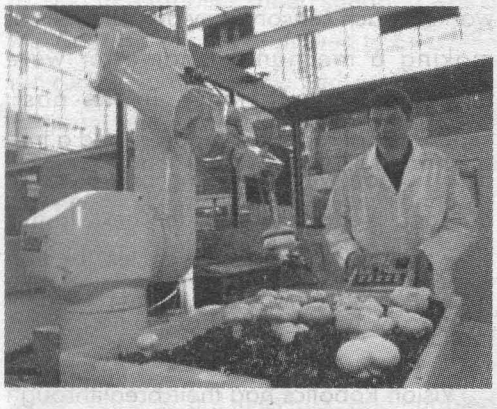
Recently Vision Robotics, a San Diego company, is working on a pair of robots that would trundle through orchards plucking oranges, apples or other fruits from the trees. In a few years, troops of these machines could perform the tedious and labor-intensive task of fruit picking that currently employs thousands of migrant workers each season. Previous attempts at making a mechanical harvester were thwarted by inefficiency. In the past, experimental machines approached a tree as a human would, picking one piece of fruit and then looking for the next. In this slow process, the machine circled the tree repeatedly until it was sure it had picked all the fruit.

Vision Robotics had their breakthrough idea right there in the orange grove. They realized that the task could be divided between two robots: One would locate all the oranges, and the second would pick them. Once you know where all the fruit is, then it becomes an easy job to calculate the most efficient way to pick it.

Robotic Mushroom Picker

Warwick researchers are working on a suite of robots and automated systems, which could transform farming and horticulture over the next decade. The researchers from the University of Warwick's horticultural arm, Warwick HRI, and its manufacturing engineering section, Warwick Manufacturing Group, are working on a number of robotics and automation products that will vastly reduce the labor costs of farmers and growers.

Those projects include Robotic mushroom picker that uses a charged coupled camera to spot and select only mushrooms of the exact size required for picking achieving levels of accuracy far in excess of human labor. A suction cup on the end of a robotic arm then picks the mushrooms. Whilst the speed of picking is currently just over half that of a human - the mushrooms and the robot can be set to



pick 24 hours a day right through the night without the need for any sort of break. The researchers also hope to increase the speed of picking too much closer to that of a human worker.

Inflatable Conveyor Belt

The Warwick Manufacturing Group and Warwick HRI researchers have helped an agricultural machinery company "Aero pick" to develop a revolutionary group of inflatable aids to harvesting which provide huge savings on labor costs. The inflatable conveyor system can be driven into an open field or covered growing area. Within minutes up to 100 meters of powered conveyor belt can be deployed allowing crops to be processed at high speed straight to cold storage, or washing, or simply sorted and graded while still in the field.

Robot Grass Cutter

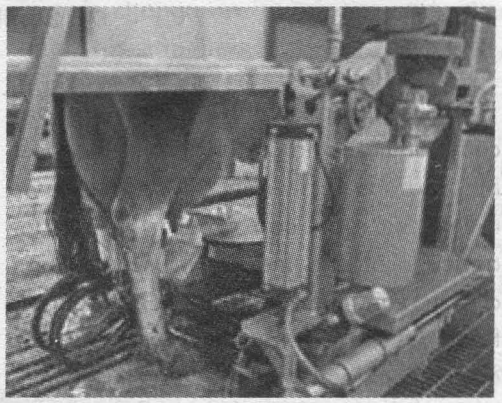
Mowing the lawn is a drudge but for growers, farmers, even golf course owners, with large amounts of grassland it's a massive problem with every tractor requiring a skilled employee to manage such pastures. Researchers in the Warwick Manufacturing Group are developing a new method which can allow a farmer or grower to deploy multiple robotic grass cutting machines at the same time all under the supervision of just a single employee. They are working with the "Ransomes Spider" grass-cutting device, which can be remotely controlled and can even mow on 40 degree inclines. They are replacing that remote control with a computer that can

use its own data sensors attached to the mower, to autonomously travel across fields working in groups with other robotic mowers ensure that the field is mowed as quickly as possible.

Robot Milker

Dr. Bruce Davies, from Pontardawe, is perfecting a flexible arm - intended to mimic an elephant's trunk - that will seek out a cow's udder and attach itself to the teats. The device offers the prospect of eliminating both the early morning and evening drudgery of milking for thousands of dairy farmers but also softening the touch of livestock farming. Dr. Davies, who was born in a farm and used to milk cows by hand as a youngster, came up with the idea for his Ph. D. and initially thought it had uses in physiotherapy until he realized that there is potential in the dairy industry. Dr. Davies' work at Heriot-Watt University in Scotland has been backed with a £98,000 grant from Nesta, the National Endowment for Science, Technology and the Arts. Robot Milker uses a mixture of a system where different sensors are used to locate the teats and are using a much more compliant, floppy arm to attach the milking cups. A "thinking camera" on the arm uses the latest in-vision software to locate the cow's teats and is said to be much more gentle when slipping on the milking cups. This system is also capable of adapting in a similar way to a human milker to the natural changes cows undergo. As cows become better milkers, the shape of the udder changes and the angle of the teats change, which is a problem for current milkers, but is something robot milker can address.

Research suggests cows adapt well to automated milking systems and that there is an increase in yield. It has been estimated that yields could increase by up to 20% if cows had a system which they could use three or four times a day.



In central Illinois, agricultural engineers are preparing robots to do the mundane farming jobs like weeding, looking out for harmful insects, and taking soil samples in a cornfield. Called "ag robots," the idea is to replace bulky farm equipment with swarms of precision helpers that can maintain an entire field autonomously.

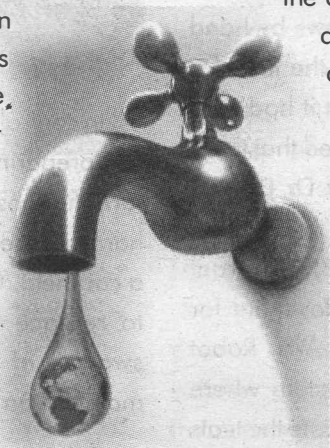
Other experimental applications of robots in agriculture include a machine for the automatic break-up of pork carcasses (Clarke, 1985), transplanting of seedlings (Hwang and Sisttle, 1985), pruning grapevines in France (Sevila, 1985), and picking apples (D' Enson, 1985), robotic weed control system in California (Lee, 1994) etc.

G.S. Unnikrishnan Nair
"Anjana"
T.C-25/3178-1
Vanchiyoor
Thiruvananthapuram – 695 035
E Mail: vanchiyurunni@gmail.com

WATER CONSERVATION AND MANAGEMENT: NEED OF THE HOUR

Dr. Sunil K. Misra

Water is one of the most abundant commodities in nature, but is also the most misused one. Only about 3% of the water resources man can tap for domestic, agricultural and industrial use. Extreme climatic conditions such as aridity, drought, flood, cyclone and stormy rainfall are expected to leave an impact on human society. Several cities and civilizations have disappeared due to water shortage originating from climatic changes. However, climate and culture can interact in numerous ways. We hypothesize that people may resort to modify dwelling environments by adapting new strategies to optimize the utility of available water by harvesting rain rather than migrating to newer areas.



One of the most serious problem that humanity face today is the global water crisis. Development of sustainable and safe drinking water supplies is a global challenge. Unfortunately people in many parts of the world are forced to live without safe water and sanitation services. The number of such people as per United Nations' Third World Water Development Report (WWRD) is more than 660 million. The WWRD is released every three years. The first report was released in 2003.

Today the agriculture sector is the largest user of freshwater globally, accounting for about 70% of total freshwater consumption. There will be greater demand of water by the agriculture sector, as the food demand is expected to be almost double in the next 50 years.

The Industrial sector accounts for about 22% of freshwater consumption globally.

The growing concern for water has been echoed in different national and international forums. At international level the first major concern for water was expressed at the UN conference on the Human Environment held in Stockholm in 1972. UN declared the year 2003 as International Year of Freshwater. The UN General Assembly at its 58th session proclaimed the years 2005 to 2015 as the International Decade for Action – Water for Life, which began on 22nd March, 2005 designated as the World Water Day.

The population of India is expected to stabilize around 1640 million by the year

2050. As a result, gross per capita water availability will certainly decline in the year 2050. Out of the total annual precipitation of about 4000 billion cubic meters (BCM), the officially assessed annual availability of water is about 1120 BCM. This provides for an annual per capita availability of less than 100 CuM, an amount that borders on a state of scarcity, according to international perceptions. With this annual amount, domestic needs, water for food production, industrial activities and cultural requirements are to be met. In doing so, water engineers in India have exhausted many rivers and aquifers, leaving little water for dilution of pollution or to satisfy all the needs of environmental flows for the aquatic ecosystems.

In the climatic condition of India dominated by acute spatial and temporal inequities in precipitation, the national averages do not bring out the stark realities of smaller regions with water extremes. The rainfall distribution over India is highly uneven over space and time.

The exhaustive exploitation of underground water has brought down the water level by 3-12 meters in just one decade. It is believed that by the year 2025, 15 Indian states will be struggling for water which has already began in some states. Actually we have the great tragedy of the ground water commons! Ownership of groundwater being treated as private, totally unsustainable extraction of water, for both irrigation and industry, has deprived large areas of peninsular India of water from easily accessible aquifers. The traditional knowledge base with which water governance is practiced in India finds it easier to declare water scarcities or excesses as 'natural disasters'.

The major reasons for India's water crisis are: high population density, time and variability of rainfall and increasing depletion and contamination of its surface and ground water. The climate change is also affecting the hydrohogical cycle. Now it is becoming obviuous that the impact of climate change on freshwater production and its distribution is going to be really significant.

The rain water harvesting and water recharging by slow percolation is the need of the hour. It is hence recommended to formulate the action plan being studied with projection in accordance with decadal growth of population.

India simply cannot continue with the traditional and simplistic approach to water management in future years. The urgent need has been flagged by many independent water professionals and social movements, but the political leadership and the governments have resisted much needed reforms in water engineering and management. People need to be involved in the management and protection of water around their habitat. The most important issue is to redefine water management or water governance. It would require institutional reforms. Education and increased public awareness and participation are paramount pre-requisites for better water management. Water future of India is in the hands of our people, water professionals, the business sector and the government. Only wise and unselfish action by all of them can regain the country's status as 'sujalang'.

Dr. Sunil K. Misra
Associate Professor
P.G. Department of Chemistry
D.A.V. College
Kanpur - 208 001
E Mail : vijnana@rediffmail.com

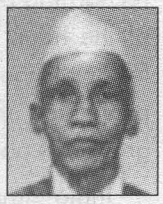
A BRIEF OVERVIEW OF INDIA'S CONTRIBUTIONS IN MATHEMATICS

Part - 2

K. Gopika and K.C. Bevita

Mathematicians born in 1900s

Dattaraya Ramchandra Kaprekar



Dattaraya Ramchandra Kaprekar was born on January 17, 1905 in Dahanu, Maharashtra. He received his secondary school education in Thane and studied at Fergusson College in Pune. In 1927, he won the Wrangler R.P. Paranjpe Mathematical Prize for an original piece of work in mathematics. He attended the University of Mumbai, receiving his bachelor's degree in 1929. Having never received any formal post graduate training, for his entire career (1930–1962), he was a school teacher at Nashik in Maharashtra. He died in 1986.

Working largely alone, Kaprekar discovered a number of results in number theory and described various properties of numbers. In addition to the Kaprekar constant and the 'Kaprekar numbers' which were named after him, he also described self numbers or Devlali numbers, the Harshad numbers and Demlo numbers. He also constructed certain types of magic squares related to the Copernicus magic square. Initially his ideas were not taken seriously by Indian mathematicians, and his results were published largely in low-level mathematics journals or privately published, but international fame arrived when Martin Gardner wrote about Kaprekar in his March 1975 column of Mathematical Games for Scientific American. Today his name is well-known and many other mathematicians have pursued the study of the properties he discovered.

Sarvadaman D.S. Chowla

Sarvadaman D.S. Chowla (22 October 1907-10 December 1995) was a prominent Indian mathematician, specializing in number theory. He was born in London, since his father, Gopal Chowla, a Professor of Mathematics in Lahore, was then studying at Cambridge. The family returned to India shortly after his birth and he was brought up in India.

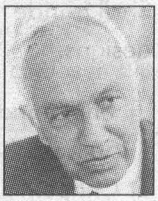
Chowla's first paper appeared in 1925 and the last in 1986. During this period of 62 years he wrote about 350 papers. His papers encompassed a wide variety of interests. He wrote on additive number theory (lattice points, partitions, Waring's problem), Bernoulli numbers, class invariants, definite

integrals, elliptic integrals, infinite series, the Weierstrass approximation theorem, analytic number theory (Dirichlet L-functions, primes, Riemann and Epstein zeta functions), and class numbers, combinatorial problems (block designs, difference sets, Latin squares), Diophantine equations and Diophantine approximation, elementary number theory (arithmetic functions, continued fractions, and Ramanujan's tau function), and exponential and character sums (Gauss sums, Kloosterman sums, trigonometric sums). Among his contributions are a number of results which bear his name. These include the Bruce–Chowla–Ryser theorem, the Ankeny–Artin–Chowla congruence, the Chowla–Mordell theorem, the Chowla–Selberg formula, and the Mian–Chowla sequence.

Lakkoju Sanjeevaraya Sharma

Lakkoju Sanjeevaraya Sharma (1907 - 1998) was a mathematician from Andhra Pradesh. He was born on 27 November, 1907 at Kalluru village of Proddatur mandal in Cuddapa district. He was born blind and had no formal education. He surprised the elite and educated people by giving many Mathematical 'Avadhanams' (Ganitavadhanams). He gave his first performance at Andhra Mahasabha at Nandyala in 1928 chaired by Sarvepalli Radhakrishnan. He was invited to New Delhi by Jawaharlal Nehru and performed before the President Rajendra Prasad and other dignitaries. He traveled widely and gave about 7,000 performances in Andhra Pradesh, Tamil Nadu, Karnataka, Maharashtra and Delhi. One of the memorable performances was given on 7th December 1966 at Sri Krishna Devaraya Andhra Bhasha Nilayam, Hyderabad. He has received many gold medals, honors and felicitations. He has prepared an Indian calendar for 4000 years. He was invited to United States in 1993 by the Telugu community. He could not attend due to Visa problem. Shri Venkateswara University honored him with Doctorate in 1996.

Subrahmanyan Chandrasekhar



Subrahmanyan Chandrasekhar was born in Lahore on 19 October, 1910. He was the nephew of C.V. Raman, the first Indian to get Nobel Prize in science. He is best known for his celebrated discovery of Chandrasekhar Limit. He showed that there is a maximum mass which can be supported against gravity by pressure made up of electrons and atomic nuclei. The value of this limit is about 1:44 times a solar mass. This was derived by Chandrasekhar in 1930, when he was a student.

One of the greatest scientists of the 20th century, he became a legend in his life time. He was a great scientist, an accomplished teacher and a formidable scholar. His prolific contributions spanned astrophysics, physics and applied mathematics. His research output is phenomenal and every monograph or book published by Chandrasekhar has become a classi serious students of the concerned fields can ignore Chandrasekhar's work. Chandrasekhar died on August 21, 1995.

Sharadchandra Shankar Shrikhande

Sharadchandra Shankar Shrikhande, born on October 19, 1917 in Sagar,

Madhya Pradesh, is an Indian mathematician with distinguished and well-recognized achievements in combinatorial mathematics. He is notable for his breakthrough work along with R.C. Bose and E.T. Parker in their disproof of the famous conjecture made by Leonhard Euler dated 1782 that there does not exist two mutually orthogonal latin squares of order 4n + 2 for every n. Shrikhande's specialty was combinatorics, and statistical designs. Shrikhande graph is used in statistical designs.

Shrikhande received a Ph. D. in the year 1950 from the University of North Carolina at Chapel Hill under the direction of R.C. Bose. Shrikhande taught at various Universities in the USA and in India. Shrikhande was a Professor of Mathematics at Banaras Hindu University, Banaras and the founder Head of the Department of Mathematics, University of Mumbai and the founder Director of the Center of Advanced Study in Mathematics, Mumbai until he retired in 1978. He is a Fellow of the Indian National Science Academy, the Indian Academy of Sciences and the Institute of Mathematical Institute, USA.

Harish Chandra

Harish Chandra (11 October 1923 – 16 October 1983) was born in Kanpur (then Cawnpore), British India. He did fundamental work in representation theory, especially Harmonic analysis on semisimple Lie groups. He is also known for work with Armand Borel founding the theory of arithmetic groups and for papers on finite group analogues. He enunciated a philosophy of cusp forms, a precursor of the Langlands philosophy. From 1968, until his death in 1983, he was IBM von Neumann Professor in the School of Mathematics at the Institute for Advanced Study, Princeton. He was a member of the National Academy of Sciences of the U.S. and a Fellow of the Royal Society. The Harish Chandra Research Institute, in Allahabad, India, is named in his honour.

Calyampudi Radhakrishna Rao

Calyampudi Radhakrishna Rao, known as C.R. Rao (born 10 September 1920) is an Indian statistician. He was born in Hadagali, Karnataka. He is currently Professor Emeritus at Penn State University and Research Professor at the University at Buffalo. The American Statistical Association has described him as "a living legend whose work has influenced not just statistics, but has had far reaching implications in fields as varied as economics, genetics, anthropology, geology, national planning, demography, biometry, and medicine." The Times of India listed Rao as one of the top 10 Indian scientists of all time.

Among his best-known discoveries are the Cramér–Rao bound and the Rao–Blackwell theorem both related to the quality of estimators. Other areas he worked in include multivariate analysis, estimation and differential geometry.
include the Fisher–Rao Theorem, Rao distance, and orthogonal arrays. He is the author of 14 books and has published over 400 journal publications.

Rao has received over 33 honorary doctoral degrees from Universities in 17 countries around the world and numerous awards and medals for his contributions to statistics and science. Rao was awarded the United States National Medal of Science, the nation's highest award for lifetime achievement in fields of scientific research, in June 2002. He was also awarded the India Science Award for 2010, the highest honor conferred by the Government of India in scientific domain. The latest addition to his collection of awards is Guy Medal in Gold (2011) of the Royal Statistical Society.

Mathukumalli Venkata Subbarao

Dr. Mathukumalli Venkata Subbarao (May 4, 1921 – February 15, 2006) specialized in number theory. He was born in the small village of Yazali, near Bapatla, Guntur district, Andhra Pradesh. He worked at Presidency College, Madras, Shri Venkateswara University, and the University of Missouri, before moving in 1963 to the University of Alberta, where he spent the rest of his professional career. A prolific collaborator, Subbarao has Erdős number 1, and more than 40 joint authors. He continued producing mathematics papers during the final years of his life. He died in Edmonton at the age of 84.

Dr. Subbarao dedicated his life to exploring the intricacies of number theory, which was once considered the purest of pure mathematics, but is now finding practical applications in unexpected places, such as computer security and cryptology. He published close to 200 research papers in mathematical journals. He contributed many important results and conjectures to the theory of arithmetical functions, and had several papers concerning the distribution of generalized K-free integers, partition functions, and the Scholz-Brauer problem in addition chains. Some of his important contributions to the field of number theory are the Aiello-Subbarao Conjecture in addition chains, the Subbarao Conjecture in partition functions, and an analogous conjecture for product partitions. Dr. Subbarao's work on addition chains is still being referred to by cryptologists, in developing secure coding algorithms.

P.K. Srinivasan

P.K. Srinivasan (November 4, 1924-June 20, 2005) was a well known mathematics teacher who taught mathematics at the Muthialpet High School in Chennai, until his retirement. He is known in India for his dedication to teaching mathematics and in creating awareness of the Indian mathematician Ramanujan. He has authored several books in both English and Tamil which introduced mathematics to children in novel and interesting ways. He was also a prominent reviewer of math books in the weekly Book Review column of the Indian newspaper The Hindu from Chennai. He was awarded the National Science Award by Government of India in 1991 and a State Award by Tamil Nadu Science and Technology Centre for popularisation of mathematics education to enable children to learn mathematics with interest and enthusiasm.

Shreeram Shankar Abhyankar

Shreeram Shankar Abhyankar was born on July 22, 1930 in a Maharashtrian Konkanastha Brahmin family in Ujjain. He is known for Abhyankar's conjecture, Abhyankar's lemma and Abhyankar-Moh theorem.

He has won numerous awards and honors such as: Fellow of the Indian Academy of Sciences, Editorial board member of the Indian Journal of Pure and Applied Mathematics, Chauvenet Prize from the Mathematical Association of America (1978) and Honorary Doctorate Degree (Docteur Honoris Causa) by the University of Angers in France (1998).

His research topics include algebraic geometry (particularly resolution of singularities), commutative algebra, local algebra, valuation theory, theory of functions of several complex variables, quantum electrodynamics, circuit theory, invariant theory, combinatorics, computer-aided design, and robotics.

M.S. Narasimhan

M.S. (Mudumbai Seshachalu) Narasimhan, born in 1932 in Anantapur, Andhra Pradesh, is an eminent Indian mathematician. He is well known along with C.S. Seshadri for their work entitled "Stable and unitary vector bundles on a compact Riemann surface".

Awards and felicitations include: Shanti Swarup Bhatnagar Prize (1975), Third World Academy Award for Mathematics (1987), Padma Bhushan (1990) and King Faisal International Prize for Science, 2006 (jointly with Simon Donaldson, Imperial College).

C.S. Seshadri

Prof. C.S. Seshadri (born on 29 February 1932) is known for his work in algebraic geometry. His work with M.S. Narasimhan on unitary vector bundles has influenced the field a lot. His work on Geometric Invariant Theory and on Schubert varieties is widely recognized. Apart from the great amount of research done by him, Seshadri's contribution includes the inception of Chennai Mathematical Institute, which is one of the leading institutes for study in mathematics in India. The Sheshadri constant is named after him. He received Padma Bhushan in 2009, the Shanti Swarup Bhatnagar Award, and the Srinivasa Ramanujan Medal from the Indian Academy of Sciences. He is Fellow of the Indian Academy of Sciences, Fellow of the Indian National Science Academy and Fellow of the Royal Society. He has also received an honorary degree from the Banaras Hindu University. He is currently Director-Emeritus of the Chennai Mathematical Institute.

K.S.S. Nambooripad

K.S.S. Nambooripad, born on 6 April 1935 in a middle class Namboodiri family in Puttumanoor near Cochin in central Kerala, is an Indian mathematician

who has made fundamental contributions to the structure theory of regular semigroups. Nambooripad was also instrumental in popularising the TeX software in India and also in introducing and championing the cause of the free software movement in India. He was with the Department of Mathematics, University of Kerala, since 1976. He served the Department as its Head from 1983 until his retirement from University service in 1995. After retirement, he is associating with the academic and research activities of the Center for Mathematical Sciences, Thiruvananthapuram in various capacities.

Vinod Johri

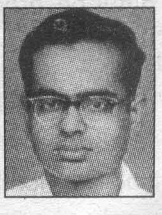
Vinod Johri was born in Etah (Uttar Pradesh) on 10 June 1935. He is an eminent cosmologist, a retired Professor of Astrophysics at Indian Institute of Technology, Madras and an Emeritus Professor at Lucknow University since 1995. He has over 75 research publications and articles published in pioneering journals. His major contributions in cosmological research include 'power law inflation, genesis of quintessence fields of dark energy and phantom cosmologies'. He is the co-author of the first model of 'Power law inflation in Brans-Dicke Theory' along with C. Mathiazhagan. He has been honored by Uttar Pradesh Government by Research Award of the Council of Science & Technology (CSIR). His research monograph "Early Universe" was published by Hadronic Press (USA) in 1996. Besides scientific research papers and popular science articles, Johri has written several books on Mathematical Physics and Astrophysics.

S. Ramanan

Professor Sundararaman Ramanan (born 20 July 1937) is an Indian mathematician who works in the area of algebraic geometry, moduli spaces and Lie groups. He completed his Ph. D. at the Tata Institute of Fundamental Research, Murnbai under the direction of M. S. Narasimhan, with whom he collaborated for decades. He later pursued a lengthy career at TIFR, with many international visits. He picked up the methods of modern differential geometry from the French mathematician Jean-Louis Koszul, and later successfully applied it for his research centered around algebraic geometry. He has also made important contributions to the topics of abelian varieties and also vector bundles.

While in TIFR as distinguished Professor, he was one of the important figures in the school of mathematics in India. He now continues his contributions *via.* teaching at the Chennai Mathematical Institute, where he is adjunct Professor. He is a great lecturer and expositor, and has written a graduate level book on Global Calculus. The honors awarded to Prof. Ramanan include the Shanti Swarup Bhatnagar Prize in 1979. He is an alumnus of the Vivekananda College in Chennai.

C.P. Ramanujam



Chakravarthi Padmanabhan Ramanujam was born on 9th of January, 1938 in Madras (now Chennai). He is known for his work in number theory and Algebraic

Geometry. It is said that he could solve difficult problems with elegance and could also make it simple in nature. This Indian Mathematician of the 20th century also showed an incredible versatility and depth in the subject. During his doctoral days, he exhibited exceptional talent and as a result was honoured with the post of Associate Professor. As a student, or it is better said as a mathematician, C.P. Ramnujam's thirst for knowledge was never quenched with easy problems, he always wanted to experiment with difficult problems. In the year 1967 when he took his doctoral examination he impressed all his teachers and it was concluded that he had extraordinary talent in the field of mathematics.

Like Srinivasa Ramanujan, his namesake, C.P. Ramanujam also had a very short life. The cause of his death was largely depression. On October 27th, 1974, at the tender age of 37, he took away his life in a feat of depression.

Srinivasa Varadhan

Sathamangalam Ranga Iyengar Srinivasa Varadhan is an Indian-American mathematician born on 2 January 1940 in Madras (Chennai), Tamil Nadu. Varadhan is currently a Professor at the Courant Institute, New York. He is known for his work with Daniel W. Stroock on diffusion processes, and for his work on large deviations with M.D. Donsker.

Varadhan's awards and honours include the Birkhoff Prize (1994), the Margaret and Herman Sokol Award of the Faculty of Arts and Sciences, New York University (1995) and the Leroy Steele Prize (1996), awarded for his work with Daniel W. Stroock on diffusion processes and National Science Medal of the US (2011) for his work on probability theory. He was awarded the Abel Prize in 2007 for his work on large deviations with M.D. Donsker. In 2008, the Government of India awarded him the Padma Bhushan. He also has two honorary degrees from Université Pierre et Marie Curie in Paris (2003) and from Indian Statistical Institute in Kolkata, India (2004).

Varadhan is a member of the U.S. National Academy of Sciences (1995), and the Norwegian Academy of Science and Letters. He was elected to Fellow of the American Academy of Arts and Sciences (1988), the Royal Society (1998), and the Society for Industrial and Applied Mathematics (2009).

M.S. Raghunathan

Professor Madabusi Santanam Raghunathan was born in Anantapur, Andhra Pradesh on August 11, 1941. He has made fundamental contributions to the Theory of Algebraic Groups. His book "Discrete Subgroups of Lie Groups" published in 1972 is a standard reference work in the area. He has been a Visiting Professor in several international centres. He is a recipient of the Shanti Swarup Bhatnagar Prize for Mathematics and also the Ramanujan Medal of the Indian National Science Academy. During 1991, 1993, he held the prestigious S.N. Bose Professorship of INSA. In 1970, he gave one of the

prestigious invited 50 minute addresses at the International Congress of Mathematicians held in Nice. In1991 the Third World Academy of Science awarded him its Mathematics Prize.

Raghunathan has been elected Fellow by several national scientific academies such as: Indian Academy of Sciences, Bangalore, Indian National Science Academy, Delhi and National Academy of Sciences, Allahabad. He is a Fellow of the Royal Society, London. Raghunathan was conferred Padma Shri in January 2001. He has been a past Chairman of the National Board for Higher Mathematics and is on the governing councils of many of the premier research institutions of the country. Raghunathan's international responsibilities include membership of the Executive Committee of the International Mathematical Union. He is currently DAE-Homi Bhabha Professor at the School of Mathematics at Tata Institute of Fundamental Research (TIFR), Mumbai.

Gopal Prasad

Gopal Prasad was born on July 31, 1945 in Ghazipur. His research interests span the fields of Lie groups, their discrete subgroups, algebraic groups, arithmetic groups, geometry of locally symmetric spaces, and representation theory of reductive p-adic groups. Prasad has received the Guggenheim Fellowship, the Humboldt Senior Research Award, and the Raoul Bott Professorship at the University of Michigan. He was awarded the Shanti Swarup Bhatnagar prize. He has received Fellowships of the Indian National Science Academy and the Indian Academy of Sciences. Prasad gave an invited talk in the International Congress of Mathematicians held in Kyoto in 1990. He is the Managing Editor of the Michigan Mathematical Journal and the Editor of the Asian Journal of Mathematics since its inception, and was formerly an Associate Editor of the Annals of Mathematics.

V.K. Patodi

Vijay Kumar Patodi (March 12, 1945 – December 21, 1976) was an Indian mathematician who made fundamental contributions to differential geometry and topology. He was the first mathematician to apply heat equation methods to the proof of the Index Theorem for elliptic operators. He was a Professor at Tata Institute of Fundamental Research, Mumbai. In the two papers based on his Ph. D. thesis, "Curvature and Eigenforms of the Laplace Operator" (*Journal of Differential Geometry*), and "An Analytical Proof of the Riemann-Roch-Hirzebruch Formula for Kaehler Manifolds" (also *Journal of Differential Geometry*), he made his fundamental breakthroughs. He was invited to spend 1971–1973 at the Institute for Advanced Study in Princeton, New Jersey, where he collaborated with Michael Atiyah, Isadore Singer, and Raoul Bott. The joint work led to a series of papers, "Spectral Asymmetry and Riemannian Geometry" (*Math. Proc. Cambridge. Phil. Soc.*) with Atiyah and Singer, in which the η-invariant was defined. This invariant was to play a

major role in subsequent advances in the area in the 1980s. He was promoted to full Professor at Toto Institute at the oge 30. However, he died at age 31, as a result of complications prior to surgery for a kidney transplant.

Shrikrishna Gopalrao Dani

Shrikrishno Gopalrao Doni (born 1947) is a Distinguished Professor at TIFR, Mumbai. He has been a member of the NBHM since 1996 and is currently the Chairman of the NBHM. He is also the Chairman, Commission for Development and Exchonge (CDE) of International Mathematical Union, for the period 2007-10. He hos served as Editor of *Proceedings (Moth. Sci.) of the Indian Academy of Sciences*, Bangolore for many yeors since 1987.

Professor Doni was awarded the Shanti Sworup Bhatnogar Prize in 1990. He received the Third World Academy of Sciences Prize in 2007. He was invited to give a talk at the International Congress of Mathematicians held in Zurich, Switzerland in 1994.

Parimala Raman

Parimala Roman was born in 1948 at Tomil Nadu. She is known for her contributions to algebra. Her research uses tools from number theory, algebraic geometry, and topology.

She is a Fellow of all three Indian academies of science. She was an invited speaker at the Internatianal Congress of Mathematicians in Zürich in 1994. Her research has been recognized with the Bhatnagar Prize in 1987, an honorary doctorate from the University of Lausanne in 1999, and the Srinivasa Ramanujan Birth Centenary Award in 2003. She received the 2005 prize in mathematics from the Academy of Sciences for the Developing World for "her work on the quadratic analogue of Serre's conjecture, the triviality of principal homogeneous spaces of classical groups over fields of cohomological dimensions 2 and the 1-invariant of p-adic function fields." Prizes to the amount of $10,000 are awarded annually to scientists from developing countries who have made outstanding contributions to the advancement of science. This was the first time in the 20-year history of the TWAS awards that a woman had been honored with the prize in either mathematics or physics.

Navin Madhavprasad Singhi

Navin Madhavprosad Singhi (born 1949) is a mathematician and a Professor at Toto Institute of Fundamental Research, Mumbai, specializing in combinatorics and graph theory. He is the recipient of the prestigious Shanti Swarup Bhatnagor Prize for Science and Technology. Singhi wrote two papers with Paul Erdôs, giving him on Erdôs number of 1. Singhi is known for his research in block designs, projective planes, line graphs, and coding theory. Singhi was born in Indore and raised in Goregaon, Mumbai and earned a M.A. in mathematics from the University of Mumboi. He earned a Ph. D. (1974) from

the same University. His advisor was S.S. Shrikhande.

R. Balasubramanian

Ramachandran Balasubramanian was born on 15 March 1951 in a small village in the Thanjavur district of Tamil Nadu. He is widely known for several significant and notable contributions in the field of Number Theory. Of particular importance among his major contributions is his 1986 proof of a 200 year old conjecture, known as the Waring Conjecture, in collaboration with two French mathematicians Jean Marc Deshouillers and François Dress. He has been the Director of IMSc since 2000.

Professor Balasubramanian is the recipient of several honours including the BM Birla Award, the Shanti Swarup Bhatnagar Award in 1980 and the Srinivasa Ramanujan Birth Centenary Award of the Indian Science Congress in 2001. He is recipient of the Chevalier de l'Ordre National du Mérite of the French Government. The Indian Government awarded him with the Padma Shri in 2006. He is a Fellow of the Indian Academy of Sciences, the Indian National Science Academy and the National Academy of Sciences. He is also the President of the Cryptology Research Society of India.

Narendra K. Karmarkar

Narendra K. Karmarkar was born on 1957 in Gwalior to a Bengali family. He was a Professor at the Tata Institute of Fundamental Research in Mumbay. He is currently working on a new architecture for supercomputing based on concepts from finite geometry, especially projective geometry over finite fields. He is synthesizing these concepts with some new ideas he calls sculpturing free space (a non-linear analogue of what has popularly been described as folding the perfect corner). This approach allows him to extend this work to the physical design of machines.

Karmarkar received a number of awards for his algorithm, some among them are:

- Fulkerson Prize in Discrete Mathematics given jointly by the American Mathematical Society & Mathematical Programming Society (1988)
- Fellow of Bell Laboratories (1987)
- Texas Instruments Founders' Prize (1986)
- Marconi International Young Scientist Award (1985)
- Frederick W. Lanchester Prize of the Operations Research Society of America for the Best Published Contributions to Operations Research (1984)
- National Science Talent Award in Mathematics, India (1972)
- The Association for Computing Machinery's Paris Kanellakis Award 2000.

Vasudevan Srinivas

Vasudevan Srinivas was born on 6th June, 1958 at Delhi. He is a Professor in the School of Mathematics at the

Tata Institute of Fundamental Research, Mumbai. His research interests are best described as algebraic geometry, and since 1994, he has been a Fellow of the Indian Academy of Sciences. His recent distinctions include the B.M. Birla Science Award (1995) and the Bhatnagar Prize (2003). He was an invited speaker at the 2010 International Congress of Mathematicians.

Dipendra Prasad

Dipendra Prasad, born in 1960, specialises in Automorphic Form and Number Theory. He is an elected Fellow of the Indian Academy of Science and the National Academy of Science. He received the B.M. Birla Prize in Mathematics for the year 1994, Shanti Swarup Bhatnagar Award for Mathematical Sciences for the year 2002 and Ramanujan Award of the Indian Science Congress for the year 2005. Fellowships received: Sloan Fellowship at Harvard University (1988-89), NSERC Fellowship of the Canadian Government (1993), Swarna Jayanti Fellowship for Mathematics awarded in the year 1998-99 for 5 years and J.C. Bose Fellowship (2010-2015).

Manindra Agrawal

Manindra Agrawal was born on 20 May 1966 in Allahabad. He obtained his B. Tech. and Ph. D. from IIT, Kanpur. He is presently, a Professor and Head of the Department of Computer Science and Engineering at Indian Institute of Technology, Kanpur.

He has co-created the AKS primality test with Neeraj Kayal and Nitin Saxena, for which he and his co-authors won the 2002 Clay Research Award, the 2006 Fulkerson Prize, and the 2006 Gödel Prize. The test is the first deterministic algorithm to test an n-digit number for primality in a time that has been proven to be polynomial in n. In September 2008, he was chosen for the first Infosys Mathematics Prize for outstanding contributions in the broad field of mathematics.

V. Suresh

Prof. V. Venapally Suresh specializes in the area of Algebra and Algebraic Geometry. Suresh was born in1966 in Vangoor, Andhra Pradesh. He is a Professor at University of Hyderabad.

Honours received includes : Shanti Swarup Bhatnagar Award for Mathematical Sciences in 2009, Invited Speaker at the International Congress of Mathematicians held at Hyderabad, India in 2010, Fellow of the Indian Academy of Sciences, Andhra Pradesh Scientist Award, 2008, B.M. Birla Science Prize, 2004 and INSA Medal for Young Scientist, 1997.

Madhu Sudan

Madhu Sudan, born September 12, 1966 in Chennai, is an Indian computer scientist. He is a Professor of Computer Science at the Massachusetts Institute of Technology (MIT) and a member of MIT Computer Science and Artificial Intelligence

Laboratory. He has made important contributions to several areas of theoretical computer science, including probabilistically checkable proofs, non-approximability of optimization problems, and error-correcting codes.

He has done outstanding work in the mathematical aspects of computer science for which was awarded the Rolf Nevanlinna Prize at the 24th International Congress of Mathematician in 2002. He was honored for his work in advancing the theory of probabilistically checkable proofs - way to recast a mathematical proof in computer language for additional checks on its validity and developing error-correcting codes. For the same work, he received the ACM's Distinguished Doctoral Dissertation Award in 1993 and the Gödel Prize in 2001. He is a Fellow of the ACM (2008).

Chandrashekhar B. Khare

Chandrashekhar B. Khare, born in 1967 in Mumbai, is a Professor of Mathematics at the University of California, Los Angeles. He completed his undergraduate education from Trinity College at Cambridge University. He finished his thesis in 1995 under the supervision of Haruzo Hida at California Institute of Technology. His Ph. D. thesis was published in the *Duke Mathematical Journal*. He proved Serre's conjecture with Jean-Pierre Wintenberger, published in *Inventiones Mathematicae*. In 2005, he made a major advancement in the field of Galois representations and number theory by proving the level 1 Serre conjecture, and later a proof of the full conjecture with Jean-Pierre Wintenberger. He is also the recipient of the Infosys Prize 2010 in the category of Mathematical Sciences.

Siddhartha Gadgil

Siddhartha Gadgil was born on 11 July 1974. His research interests are: Low-dimensional topology including 3-manifold topology and geometric topology of smooth 4-manifolds and Geometric Group theory in particular connections with and applications of topology. He was awarded the Sloan Dissertation Fellowship in Mathematics (1998-99). He is an Associate of the Indian Academy of Sciences (2003-2008).

Manjul Bhargava

Manjul Bhargava is a Canadian-American Professor of Mathematics at Princeton University, and of Indian origin, born in 1974. He is the second youngest full Professor at Princeton, after Charles Fefferman. He became a Professor at the Princeton at the age of 24.

His research interests span algebraic number theory, combinatorics, and representation theory. His Ph. D. thesis generalized the classical Gauss composition law for quadratic forms to many other situations. One major use of his results is the parameterization of quartic and quintic orders in number fields, thus allowing the study of asymptotic behavior of arithmetic properties of these rings. His research includes fundamental

contributions to the representation theory of quadratic forms, to interpolation problems and p-adic analysis, and to the study of ideal class groups of algebraic number fields. In July 2010 Manjul Bhargava and Arul Shankar proved a special case of the Birch and Swinnerton-Dyer conjecture.

He has won several awards for his research, including the Morgan Prize in 1996, the Merten M. Hasse Prize from the MAA in 2003, a Clay Research Fellowship, the Clay Research Award in 2005, and the Leonard M. and Eleanor B. Blumenthal Award for the Advancement of Research in Pure Mathematics. He was named one of Popular Science Magazine's "Brilliant 10" in November 2002. He recently won the American Mathematical Society's Cole Prize in number theory and the $10,000 SASTRA Ramanujan Prize, shared with Kannan Soundararajan, awarded by SASTRA in 2005 at Tanjavur, India, for his outstanding contributions to number theory. In 2008, Bhargava was awarded the Cole Prize.

Akshay Venkatesh

Akshay Venkatesh, born on 21 November 1981 in New Delhi, is an Indian Australian mathematician. His research interests are in the fields of counting, equidistribution problems in automorphic forms and number theory, in particular representation theory, locally symmetric spaces and ergodic theory. He has made far-reaching contributions to a wide variety of areas in mathematics, including number theory, automorphic forms, representation theory, locally symmetric spaces and ergodic theory, by himself or collaboration with several mathematicians.

He has won medals at both the International Physics Olympiad and International Mathematics Olympiad, at the age of 12. At the age of 13, he entered the University of Western Australia as the youngest ever student at the institution and was awarded First Class Honours in Pure Mathematics in 1997, the youngest ever to achieve this feat, as well as being awarded the J.A. Woods Memorial Prize for being the leading graduating student of the year. He held a Clay Research Fellowship from the Clay Mathematics Institute from 2004 to 2006, and was an Associate Professor at the Courant Institute of Mathematical Sciences at New York University. He was awarded the Salem Prize and the Packard Fellowship in 2007. He also won the 2008 SASTRA Ramanujan Prize. Since September 1, 2008, he is a Professor at Stanford University.

Kannan Soundararajan

Kannan Soundararajan is an Indian mathematician born in 1982. He grew up in Chennai. He represented India at the International Mathematical Olympiad in 1991 and won a Silver Medal. He is currently a Professor of Mathematics at Stanford University.

His main research interests are in

number theory, but that forces him to work with ideas from harmonic analysis, combinatorics and probability. He is a recipient of the Morgan Prize, the Salem Prize, and the SASTRA Ramanujan Prize.

Sucharit Sarkar

Sucharit Sarkar, born in 1983 in Calcutta, is currently a Ritt Assistant Professor at Columbia University. He is a Clay Research Fellow. His research area is low dimensional topology. He is currently working on Heegaard Floer homology for three-manifolds and knots inside three-manifolds.

He represented India at IMO in 2001, 2002 and secured Gold medal and silver medal respectively.

T.V. Padmakumar

With no formal academic qualification in Mathematics, a young man has discovered the amazing properties of magic squares. Padmakumar, received fellowship ifrom the State Science, Technology and Environment Department (STED), Govt. of Kerala during 1997-2001 and has published the wonderful properties of the magic square called Sri Rama Chakra in the international mathematical journal, *Fibonacci Quarterly* in August 1997.

His latest research findings are on the peculiar properties of number 384. In fact, using Sri Rama Chakra-like 4 x 4 squares, only 384 strong magic squares can be formed. Padmakumar had presented a paper on the peculiar properties of Sri Rama Chakra in the national seminar, Aryabhatiya 2001. His latest findings are based on certain mathematical properties of planets in the solar system. Such details are included in the manuscript of the book on Sri Rama Chakra he has prepared for STED.

Shri Padmakumar has spoken on the contributions of ancient India in mathematics to audiences in many research institutions, including Kerala University. He received the best paper award in Physical Science section of Indian Science Congress held in Trivandrum in 2010.

Conclusion

There does not seem to have been a time in Indian history when mathematics was not being developed. In ancient time, it was mainly used in an auxiliary or applied role. Later, from the classical period onwards, mathematics was being studied for its own sake, as well as for its applications in other fields of knowledge. Indian contribution to mathematics continued in the Mughal and medieval period and in the modern age. The picture is not yet complete as more and more Indians are coming up with outstanding innovations in the field of mathematics.

K. Gopika and K.C. Bevita
IV Semester Engineering Physics
National Institute of Technology
Calicut
E Mail: gopika.k.gangadharan@gmail.com
bevitakc@gmail.com

SLEEPING BEYOND THE EARTH

P.A. Sabareesh

(Here is an imaginative and fictional article – Editor)

Increasing population has always triggered panic among the researchers regarding their settlement on earth. Even though it is a known fact that earth has its own specialties in supporting life, science and technology has grown to such an extent that a mini chamber over the size of an average room can be created in some uneven place wherein humans can avail the basic requirement to lead a normal life. Researchers say that the day is not far away, when the earth's population explodes and humans would go in search of land, beyond the earth!!!

Let us say that we would go to moon, the earth's natural satellite. Atmospheric temperatures that go several degrees below the freezing point and sometimes rise above the boiling point, irregular landscape with deep and dark craters, miles and miles of land without green vegetation and sign of life. Above the head revolves a beautiful big blue ball with irregular white and green patches. The humans in moon would call their night as "full earth night" like we call full moon night. One would wear a spherical glass tank covering his head and look as fat as a jersey cow. Thanks to the zero gravity in moon that keeps him free from any hard work like lifting and pulling, even walking. Humans would start building cities under huge umbrella like glass chambers and start leading an ultramodern life after ages of work.

A visitor from the earth arrives to see the technology upgradation in the moon. He shares with them the situation of life at earth and welcomes them to visit their ancestral planet. Earth by now has become a dump yard of electronic and plastic wastes, governments fighting for territories and people walking down the streets with hunger and deficiency diseases. All the water sources are polluted with toxic wastes making them unfit for domestic uses. List of endangered animals break the limit and humans become merciless to slaughter wild animals.

The humans from moon are astonished to see the interior of the 'beautiful big blue ball' that they saw from their homeland. Sight of malnourished children and spreading epidemic diseases create a willingness in them to transform their ancestor's birth planet. They try to set things upright, but the governments think them as intruders and deny them irrespective of their efforts to cleanse the earth. When they feel that nothing can be done to change this situation, they return back to moon after erecting a monument at the space station. The monument portrayed a man's various stages of scientific and technological development and the last stage showing a little child pointing its forefinger towards the sky straight above. Below the monument is a permanent brief note and an address. It said,

"WE LEARNT ALL THOSE, THAT WE SHOULD'NT FOLLOW"

By,
Prince Meteor
Chief Environmentalist
The O2 Corporation
Dark Angel City
1112th Mile, Aitken Crater
South Pole-Aitken Basin
MOON

P.A. Sabareesh
Flat No. 6, Ashwini Apartment
Mahakavi G. Road
Cochin - 682 011
E Mail: sabareesh.pa@gmail.com

SCIENCE OF THE MONTH

NOVEMBER 2011

N.S. Arun Kumar

November 1: India's most populous state Uttar Pradesh greeted the arrival of the world's seven billionth baby, yesterday morning. The symbolic seven billionth baby is a girl child named *Nargis*, born to Ajay and VeenitaYadav of Dhanaur village in Mall block on the outskirts of Lucknow, the capital of Uttar Pradesh. Celebrations were also being held in the Philippines, where *Danica May Camacho* was named the seven billionth baby. In Bangladesh, authorities named another baby girl *Oishee* as the world's seven billionth child. With countries across the world, including Combodia, staking claim to being home to the seven billionth baby, UN Chief Ban Ki Moon said his office would not be able to pin-point who the world's seven billionth inhabitant is and where the baby was born. Link: http://planindia.org

November 2: The Forest Department of Kerala has just completed the first-ever ornithological survey for the Malabar region recording 341 species of birds.The survey spanned locations in North Kerala, which covers Palakkad, Malappuram, Kozhikode, Wayanad, Kannur and Kasargod districts. Yellow-browed Bulbul (*Iole indica*) is credited with the highest density (122.4 birds/sq km).22 of the 341 species surveyed belong to globally-threatened category as notified by IUCN. Alarmingly, of the 22 threatened species 17 are residents and, of which nine are specifically endemic to Western Ghats. The survey was conducted by an efficient team of five ornithologists led by Shri. C.Sasikumar. Link:http://www.keralaforest.org

November 3: A group of 31 Indian scientists from Indian Council of Agricultural Research (ICAR) Institutes, State Agricultural Universities and Banaras Hindu University, have achieved a break through in decoding the genome of Pigeon pea (*Cajanus cajan*), the second most important pulse crop of India. The pulses variety also known as *'Arhar'* and *'Tur'* is an important grain legume crop of India. About 85% of the world Pigeon pea is produced and consumed in India where it is a key crop for food and nutritional security of the people. India imports Pigeon pea from Myanmar which is the second largest producer.This is the first plant genome sequenced entirely through a network of Indian institutions. Link: http://www.nrcpb.org

November 4: The genome of Wheat - the most important crop globally - will be cracked within the next three years. Indian scientists have joined 16 other nations - the US, the UK, France, Italy, Switzerland, Germany, Czech Republic, Norway, Israel, Turkey, Russia, China, Japan, Australia and Argentina - in the initiative.The Department of Biotechnology (DBT) has sanctioned about ₹ 34 crore for over four years to three institutes - Punjab Agriculture University, ICAR and Delhi University, for the project which is likely to be completed in five years. Wheat has 21 chromosomes and each will be decoded by the 21 Indian scientists.

Once wheat's genetic code is cracked, it will help in developing disease-resistant wheat faster. Link: http://www.wheatgenome.org

November 5: Indian scientists are working on a device to detect tuberculosis (TB) in the early stage of the disease by trapping human breath in air-tight plastic jars. An electric nose that would sniff out sick molecules in a person's breath is being developed by a four-member research team at the Delhi-based International Centre for Genetic Engineering and Biotechnology (ICGEB) to produce a faster diagnosis of the deadly but curable disease. Late detection of this infectious illness means most patients are treated at advanced stage. Available tests take days, sometimes weeks, to show results. Early diagnosis and timely treatment could potentially save lives, reduce medical costs and prevent the spread of infection. Link: http://www.icgeb.org

November 6: Revolutionizing cancer treatment throughout the world and serving as an excellent example of highly effective patient-oriented research, the Eldorado Cobalt-60 radiation technology, nicknamed the "Cobalt Bomb", was first installed at London Health Science Centre on October 23, 1951. This was world's first cancer treatment with Cobalt-60 radiation which took place at Victoria Hospital. This marked an important milestone for both the fight against cancer and LHSC's emergence as a leader in the field of radiotherapy. Cancer treatment technologies have steadily progressed since the introduction of the mega-voltage period in 1951. Today, linear accelerators with more penetrating x-rays and built-in 3D imaging capabilities are used in most developed countries. Link: http://www.lhsc.on.ca

November 7: Almost 28 years after it set up the first permanent research station in the South Polar region, India is all set to commission and occupy third such station, named as 'Bharti', in Antarctica by March next year. After 'Bharti' becomes operational, India will join the league of select nations that have multiple operation stations in the region. The new station is located almost 3,000 km away from the existing 'Maitri' station which has been serving the nation since its inception in 1988-89. India's first station in Antarctica was Dakshin Gangotri (1983). After decommissioning, it had been marked as a historic site. Link: http://www.ncaor.gov.in

November 8: A 400m-wide (1,300ft) asteroid will pass by the Earth today, closer to it even than the Moon. It poses no danger to the Earth and it will be invisible to the naked eye. Asteroid 2005 YU55's closest approach, at a distance of 325,000 km, will be at 2328GMT. It is the closest the asteroid has been in 200 years. It is also the largest space rock fly-by the Earth has seen since 1976; the next visit by such a large asteroid will be in 2028. Two radio telescopes - the Goldstone Observatory in California, US and the Arecibo Observatory in Puerto Rico, US - will be tracking radio echoes off it in a bid to understand better what it is made of and how it is shaped. Link: http://www.gdscc.nasa.gov

November 9: A recent butterfly survey in the North Wayanad Forest Division of Kerala organized jointly by the Ferns Naturalists Society, an environment organization, and the Forest and Wildlife Department reported the sighting of 140 species, including 17 which had not been hitherto reported in the region. Rare species such as Yellow-Jack Sailer and Club Beak were sighted at the Thirunelly reserve forest.

Species such as Orange Awlet, Nilgiri Tiger, Tamil Lacewing, and Malabar Banded Swallow-tail were sighted in the Periya reserve forest, Brahmagiri Hills, Hilldale reserve forest, and at the Kunjome forest.The new species in the region included Black-Veign Sergeant, Dark Pierrot, Nilgiri Tiger, Blue Pansy, Common Banded Demon, and Yellow-Jack Sailer. Link: http://www.butterflieskerala.com

November 10: Indian-born scientist Har Gobind Khorana, who won the 1968 Nobel Prize in Physiology or Medicine, died in United States. He was 89. Khorana was born in 1922 in Raipur village of that part of Punjab which is now part of Pakistan. He was Massachusetts Institute of Technology (MIT)'s Alfred P. Sloan Professor of Biology and Chemistry Emeritus. In 1976, Khorana achieved the synthesis of the first fully functional man-made gene in a living cell. He was among the pioneers of the now-familiar series of three-nucleotide Codons that signal to the cell which amino acids to use in building proteins, for example, Uracil-Cytosine-Uracil, or UCU, codes for the amino acid Serine, while CUC codes for Leucine. Link: http://www.biochem.wisc.edu

November 11: Russia has launched an audacious bid to scoop up rock and dust samples from the Martian moon Phobos and bring them back to Earth for study.The dusty debris should provide fresh insights into the origin of the 27km-wide moon that many scientists suspect may actually be a captured asteroid.The mission is called *Phobos-Grunt* - "grunt" means "soil" in Russian.The venture is also significant because it is carrying China's first Mars satellite-*Yinghuo-1*. But as per the latest report, the probe is stuck in its earth orbit as its engines failed to fire. After the booster rocket put the spacecraft on a support orbit around the earth the probe's own engines were to start to put it on a trajectory to Mars, but they did not. Link: http://www.russianspaceweb.com

November 12: A "forgotten hero" of Scottish science is to be honoured by the Royal Society of Chemistry. It is to announce the award of a chemical landmark plaque to mark the 200th anniversary of James Young's birth in Drygate, Glasgow.By opening the world's first oil refinery, he laid the foundations for the modern oil industry. His innovation in 1851, nine years before the Americans started drilling for oil, created a shale oil boom around the Bathgate refinery in West Lothian.Young also funded philanthropic projects, financing explorer and anti-slavery campaigner David Livingstone's African journeys.But, since his death in 1883, Young's fame has waned. Link: http://www.rsc.org

November 13: Scientists claim to have discovered two huge sunken islands in the Indian Ocean, which once formed part of the last link between India and Australia. A team from Sydney University, Macquarie University and the University of Tasmania say the two islands, about the size of Tasmania, were once part of the supercontinent Gondwana and are more than 1.5 kilometres underwater. The discovery was made while the scientists were mapping the seafloor of the Perth Abyssal Plain.The islands, called "micro continents", were formed when India began to move away from Australia, 130 million years ago during the Cretaceous period, when dinosaurs roamed the Earth. Link: http://www.indianoceanhistory.org

November 14: Scientists from Centre for Cellular and Molecular Biology (CCMB), Hyderabad have named their newly

discovered bacteria as an honour to India and Indian scientists. *Bacillus isronensis* was named in honour of ISRO while another microbe from a Himalayan glacier was named after CCMB (*Bacillus cecembensis*). Another microbe from Antarctica was christened as *Arthrobacter gangotriensis* in memory of Dakshin Gangotri, the first Indian research station set up in Antarctica. One of the microbes found in Indian Ocean was named in honour of the founder-director of CCMB, P.M. Bhargava (*Bhargavaea cecembensis*). The other names are *Indibacter alkaliphilus, Pedobacter himalayensis, Bacillus aryabhattai* and *Sphingobacterium antarcticus.* Link: http://www.ccmb.res.in

November 15: The Jim Corbett National Park here on Tuesday opened its gates to wildlife enthusiasts for a landmark season, having turned 75. The park will now remain open to visitors till June 15 next year. While Corbett has succeeded in recent times in making the surrounding community active stakeholders in its activities, there was a need to frame central-level policies on tourism to solve problems related to sustainable tourism that is currently faced by parks all over India, including Corbett. To mark the platinum jubilee, there is a newly introduced online reservation system for visitors.Visitors looking to book passes for entry to the park can now log in to corbettonline.uk.gov.in to make their reservations. Link: http:// www.corbettnationalpark.in

November 16: A team of scientists at the Indian Institute of Petroleum (IIP) has developed a new technology to convert environmentally-hazardous plastic into petroleum products. After nearly a decade-long experiments, the team of six scientists of IIP led by its Director Madhukar Omkarnath Garg has managed to achieve a breakthrough in developing a "combination of catalysts" which can convert the plastic either into gasoline or diesel or aromatics along with LPG as a common byproduct. Moreover, the process is completely environmental friendly as no toxic substances are emitted. The unique features of the technology is that liquid fuel-gasoline and diesel, meets Euro III fuel specifications and different products can be obtained from the same raw material simply by changing the catalysts and operating parameters. Link: http://www.iip.res.in

November 17: GP Birla Observatory and Astronomical Research Centre, one of the amateur observatories in the country will be opened in Hyderabad today. The GP Birla Observatory and Astronomical Centre is situated within the sprawling BM Birla Science Centre, which is a tribute to one of the greatest visionaries and philanthropists of India, Padma Bhushan Late Shri Ganga Prasad Birla. The roof of the building the Astronomical Observatory houses the powerful C-11 Telescope which is an ultra modern compact telescope instrument capable of detecting even Exoplanets. This has been set-up in collaboration with Uranoscope De France. The Observatory is an Indo-French collaborative effort and is one of the few public observatories in India. Link: http:// www.birlacorporation.com

November 18: According to scientists from the University of Texas at Austin –a pleasant city by the way– as well as other contributing scientists, they've discovered what they believe to be a large body of liquid water on Jupiter's moon Europa. The body of water is so large, they compare it to the North American Great Lakes. The water could represent a potential habitat

for life, and many more such lakes might exist throughout the shallow regions of Europa's shell, lead author Britney Schmidt, a Post Doctoral Fellow at The University of Texas at Austin's Institute for Geophysics, writes in the journal *Nature*. Based on similar processes seen here on Earth, the researchers developed a four-step model to explain how the features form on Europa. Link: http://www.nature.com

November 19: India's longest distance travelling train, Dibrugarh-Kanyakumari Vivek Express was flagged off at Dibrugarh Railway Station, Assam today. The weekly train (15905/15906) will travel a distance of 4,286 kilometres from Dibrugarh railway station to Kanyakumari through the states of West Bengal, Orissa, Andhra Pradesh, Tamil Nadu and Kerala. The train will reach its destination in about 82:30 hours.The train has been christened as Vivek Express in the name of the great saint Swami Vivekananda. Earlier, the longest distance travelling train was the Himsagar Express, which travels from Jammu Tawi to Kanyakumari, covering a total distance of 3715 kilometres in about 71 hours. Link: http://www.indianrail.gov.in

November 20: Two species of frogs found in Kerala are endangered, a study has found. The Green-eyed Bush Frog and the Resplendent Shrub Frog, found in the Western Ghats and in Munnar, have been listed as 'critically endangered' species in the paper published in the November issue of the *IUCN magazine*.The Bush frog, whose scientific name is *Raorchestes chlorosomma*, is found in the hilly areas of Munnar. Another is the "Shrub frog" found only in certain parts of Anamudi. Its scientific name is *Raorchestes resplendens*.The "Shrub frog" was found in 3 sqkm of the Eravikulam National Park in Munnar. Redline Torpedo Barb (*Puntius denisnii*) colloquially named "Miss Kerala", an ornamental fish found in the Western Ghats and in certain parts of South India, was also termed critically endangered. Link: http://www.iucn.org

November 21: A group of international scientists from India, Tanzania and Thailand are doing a research to find out the ideal variety of 'Bitter gourd' that could beat diabetes.Today, India has the highest rate of diabetes in the world. The city of Hyderabad has been selected for 'Project Bitter Gourd' as it has emerged as the diabetes capital of the country. As many as 10 hybrids of the Indian bitter gourd are being studied for their germplasm and chemical constituents, particularly *Momordicin*. The higher the content of *Momordicin*, the higher is the anti-diabetes effect. Along with the Indian hybrids, 10 hybrids from Thailand are also included in 'Project Bitter Gourd' which is sponsored by the Asian Vegetable Research and Development Centre. Link: http://www.bitter-gourd.org

November 22: Assam has declared tea as the 'state drink' in a bid to encourage the industry. Going one step forward, former president APJ Abdul Kalam described tea as India's 'national drink' saying over 22% of tea produced worldwide is consumed in India. The declaration came at the inaugural function of the three-day World Tea Science Congress. Indian Tea Board's main focus in the 12th Plan was to brand Indian tea under one umbrella and one logo. As the country was losing out major markets due to inadequate promotions, he said, an aggressive programme called "555" would be introduced in five focus countries for five years and for five identified activities. The

five countries are Russia, Kazakhstan, USA, Iraq and Egypt which are the biggest buyers of Indian tea. Link: http://www.tocklai.net/teacongress

November 23: Four of the seven countries bordering the Himalayas, India, Bangladesh, Nepal and Bhutan have agreed to work together to deal with the harmful effects that climate change is expected to bring to the region. They met at the Climate Summit for a Living Himalayas in Thimphu, Bhutan, last weekend. There, they agreed to work together on issues including food and water security. All four countries rely on melt water from Himalayan glaciers. Historically, Himalayan countries have rarely worked together, but to have a lasting impact, though, the group will need to include China, Pakistan and Afghanistan. Link:http:// www.bhutanclimatesummit.org.bt/main/index.php

November 24: The first night-flowering orchid known to science has been discovered by botanists on the island of New Britain, near Papua New Guinea. The new species, called *Bulbophyllum nocturnum*, is the first which has flowers which consistently open up at night and close in the morning, say botanists. It was found by Dutch orchid specialist Ed de Vogel. According to de Vogel, the buds would flower at 10pm before closing again around 12 hours later. The flowers only last one night. Botanists aren't sure why this species flowers after dark but suggest it might be because its pollinators are midges which forage at night.The newly-described orchid belongs to a group of species called Epicrianthes. Link: http://www.kew.org

November 25: Researchers at the University of Massachusetts Medical School have released the full genomic sequence of Monarch butterfly. This adds a new fame to this iconic butterfly, which is famous for its ability to travel up to 2,000 miles from North America to central Mexico every fall. The new genome is the first for any butterfly. It is also the first complete genome of any long-distance migrant.The researchers focused their genome analysis on pathways known to be critical for this migration, including those responsible for vision, the circadian clock, and oriented flight.The genome also revealed the complete set of genes required for synthesizing juvenile hormone.The findings appeared in November 23rd issue of the *Cell*. Link: http:/ /www.sciencedirect.com

November 26: Noted Professor and Dean of Core Academic Programmes at Inter University Centre for Astronomy and Astrophysics, Thanu Padmanabhan, have been selected for the Third World Academy of Sciences (TWAS) Prize in Physics for 2011. Padmanabhan has been awarded for developing a thermodynamical perspective in which gravity arises as an emergent phenomenon and for contributing significantly to understand dark energy, TWAS said in a statement. TWAS is an autonomous international organization, based in Trieste, Italy, that promotes scientific excellence for sustainable development in the South. He is also currently the Chairman of the Astrophysics Commission of International Union of Pure and Applied Physics. Link: http:// www.iucaa.ernet.in

November 27: The world's biggest extraterrestrial explorer, NASA's Curiosity rover, rocketed toward Mars on Saturday

on a search for evidence that the red planet might once have been home to itsy-bitsy life. It will take 8 1/2 months for Curiosity to reach Mars following a journey of 354 million miles.An unmanned Atlas V rocket hoisted the rover, officially known as Mars Science Laboratory, into a cloudy late morning sky. A Mars frenzy gripped the launch site, with more than 13,000 guests jamming the space center for NASA's first launch to Earth's next-door neighbor in four years, and the first send-off of a Martian rover in eight years. It is the first astrobiology mission to Mars since the 1970s-era Viking probes. Link: http://marsprogram.jpl.nasa.gov/msl.

November 28: Representatives from 194 countries and thousands NGOs are gathering today in Durban, South Africa, to participate in a new round of climate negotiations, including how to extend the Kyoto Protocol. The Durban Conference, the COP 17, will hold from November 28 to December 9, aiming to make efforts to reduce greenhouse gases emissions under the United Nations Framework Convention on Climate Change (UNFCCC). Efforts to negotiate a successor to the Kyoto Protocol, which committed industrialized nations to reducing greenhouse gas emissions by a set amount by 2012, have been on hold since the failure of the climate conference in Copenhagen.The conference will also consider ways to raise $100 billion a year for the Green Climate Fund to cope up with global warming. Link: http://www.cop17-cmp7durban.com

November 29: The International Cooperation to Sequence the Atlantic Salmon Genome (ICSASG, the "Cooperation") has awarded the Phase II contract for next-generation sequencing and analysis of the Atlantic Salmon genome to the J. Craig Venter Institute (JCVI) in Rockville, Maryland. JCVI will be sequencing the Salmon genome using next-generation technologies, including assembly to integrate Sanger and next-generation sequence, and comparative genomics. This effort is expected to generate a high-quality resource for those responsible for the management of wild Salmon stocks and the Salmon aquaculture industry, as well as providing a reference genome for work with other Salmonids. The Salmon genome is large and contains repetitive sequences which make it a more difficult sequencing effort. Link: http://web.uvic.ca/grasp

November 30: The 24th Kerala Science Congress will be held in Kottayam at the Rubber Research Institute of India (RRII), also a co-organiser, at the latter's premises from January 29 to 31, 2012. The Kerala State Council for Science, Technology and Environment is the primary organizer for the event, which is the only established State-level science congress. The special theme for the impending event is '*Climate change: Plantation crops and spices of Kerala*'. There will be a panel discussion exclusively on '*Science communication and Journalism*'. Particular thrust will be given to encourage young researchers through Young Scientist Awards and the Children's Science Congress. Link: http://ksc.kerala.gov.in

N.S. Arun Kumar
CP 11/65, Cresent Apartment
Idimuzhikkal
Chelambra P. O.
Malappuram - 673 634
E Mail: yeyenyes@gmail.com
www.aknscience.blogspot.com

SCIENCE BEHIND - NATURAL METHODS

D. Bheemeswar

There are so many unanswered question regarding the interpretation of modern sciences and techniques and natural methods of selection for continuation of life, which may be used for the betterment of the mankind. Especially the dynamics behind the super fluid flows charged electronically may highlight, the importance of the spiritual and meditational methods like practice of chanting of words in rhytmatic manners and yoga and meditation techniques. Some of these may extend the life for prolonged periods in good health, and also improve the quality of life.

Laws of motion says that:

1. Until and unless a force is exerted on a body it can not be moved. In reverse way 'a rolling stone never gathers mass', meaning that an idle person is physically and mentally no good for the society.
2. Rate of change of momentum is equal to force applied on the body. If the person is physically and mentally in the right direction, he can reach the destination where he can guide others to prosperous life.
3. Every action has equally opposite reaction, any mental blocks shall bring back to the state from which the person has started or goes on in circles.

This give us an idea that those who ever doesn't understand the fundamentals of life, and do not put their efforts in right direction shall create problems for themselves and also to the entire life on this earth. To put one on right track depends on the education and training one has and also ethics and morals with which the person was brought up.

Here comes the practice of the spirituality, meditation, yoga and chanting of words rythmatically. This makes all the people united as self realization takes place, that is we are all humans first, and all the religions came later, which are useful only for self realization if one follows in right direction.

Coming back to idle stones. A lot of air borne dust or bacteria or fungus or viruses shall try to grow on this if the humidity and whether conditions are appropriate. It may be only temporary but on interaction process it shall try to dominate and make the soil fertile on which we can grow some plants.

Therefore there is no waste on this earth; only we have to understand it and try in another way. For this we need like-minded persons. At present environmental pollution levels it is a must.

Conservation of energy

Overall energy of the system never

changes; it may be in different forms, like electromagnetic radiations, vibrational energy, heat energy, chemical energy etc. This means $E=MC^2$ can also be reversed. Chlorophyll absorbs light radiations and stores into chemical energy, slowly but steadily. Same chemical energy when burnt slowly and steadily gives out almost the same light radiations. This means a person who knows the art of breathing and meditations with controlled food can control his body physically and mentally well, just like young children, the persons life may extend.

Kinetics and Dynamics

Potential energy plus the kinetic energy of the system before and after the reformation must be equal.

$PE_1 + KE_1 = PE_2 + KE_2$, $h_1 + m_1v_1^2/2 = h_2 + m_2v_2^2/2$ or

$(m_2v_2^2 - m_1v_1^2)/2 = (h_2 - h_1)$, in case the mass is same, then

$m(v_2^2 - v_1^2)/2 = (h_2 - h_1)$

This implies that the more stored chemical energy one spends, the more dynamic he is, or one who is more active shall spend more chemical energy.

Hormones, Steroids, Enzymes and Pheromones

Most of the steroids or enzymes or hormones do have a chain R over a head or tail of a C-H – (N) structures. This R can be $(OH)^-$ or radical chains of $[(CH_2)_n (CH_3)]^-/(OH)^-$ Our body can absorb only two chains in unison of the same type, in which we can include the peptides/glucoses/amino acids etc. Thus, absorbed either functions as hormones ligands/crown ethers/pheromones in the presence of alkaline materials present in the blood stream. All of these elements are super charged inside the ducts of veins. As our body also contains some amounts of C_{14} and K_{40} which are known for radiating energy while undergoing to their natural state of C_{12} and K_{39}, these radiations moves electrons so fast that the entire fluids of blood go into plasma state. That is the super-conducting state. Thus the signals move across the body at lightening speeds, so as the reactions. During these reactions keeping the steady rate of reactions and also to free the blood from free radicals, the antioxidants are very important. To make this workable, one needs extra care in food selection as well as very good exercise along with some meditations, which may keep body and mind in tune. Such a healthy body can also absorb some radiations along with sound vibrations which are in tone with the body and may require very little food.

Conclusions

1) We are yet to understand Nature and its techniques by which it maintains the life on this earth.
2) We are yet to discover the principles behind fundamentals of life maintenance and its continuance on this earth.
3) We are yet to develop better techniques for meditation, yoga and different method of chanting of the words
4) We are yet to understand the dynamics behind the life, by which we make better life.

D. Bheemeswar
IP Coordinator, IPMD/RPBD
National Institute for Interdisciplinary Science and Technology
Thiruvananthapuram – 695 019
E Mail: dbjeemeswar@gmail.com

NITRIC OXIDE: MORE A HERO THAN A VILLIAN ?

Dr. S. Dileesh

The terms green house effect and global warming are now very familiar to even a laymen. These are not confined within the intellectual scientific communities. Even though not fully understood, the science behind these terms, the common people horribly experience the worse effects of global warming and climate change. So it makes me an easy job to enter into the article without going deep into the topic, global warming. In this article, I would like to go through the positive rather than the negative effects of a well known oxide of nitrogen gas, Nitric Oxide (NO).

When we articulate the term global warming and its ill effects, our discussions usually begin from green house gases and end with the protocols by various countries to cut off their emission. The main green houses gases, as is well known to everyone are Carbon dioxide (CO_2), Methane (CH_4), Water Vapour and Oxides of nitrogen gas. As we know, green house gases are needed in a minimum amount to sustain our atmospheric temperature. But when their emission exceeds, the temperature of the earth increases, leading to global warming and changes in the climate pattern. The chief green house gases produced by nitrogen are Nitrous oxide (N_2O), Nitrogen dioxide (NO_2) and Nitric oxide (NO) and are generally represented as (NO).

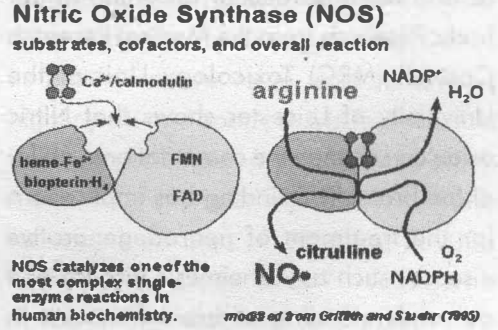
Industrial revolution and the beginning of green revolution have caused imbalance of nitrogen cycle in the environment. The main reason was the excess use of the nitrogen containing fertilizers in agriculture. Large scale burning of fossil fuels such as coal and oil releases oxides of nitrogen as smoke. Another contributor to the increased nitrogen levels are burning of trees and plants for agriculture and manufacturing of nylon.

Among the three main oxides of nitrogen, the more potent green house gas which causes global warming is Nitrous oxides (N_2O), better known as 'Laughing gas. The possible remedies to avoid the further effects of global warming can be done by reducing the emissions of these Nitrogen oxides. These are well monitored and studied by our eco friends. But Oxides of nitrogen, especially Nitric oxide (NO) is not a serious global warmer even if it is categorized among the green house gases. So as the title of the article suggests, I would like to comment on some healthy aspects of Nitric oxide (NO), especially its role as a neurotransmitter and in other fields of medicine.

A neurotransmitter is defined as a

chemical messenger that is released from the synaptic terminal of a neuron at a chemical synapse that diffuses across the synaptic cleft and binds to and stimulates the post-synaptic membrane. In simple words it is a chemical messenger released from one nerve cell which makes its way to another nerve cell where it influences a particular chemical reaction to occur. Neurotransmitters control major body functions including movement, emotional response and the physical ability to experience pleasure and pain. There are many different ways to classify neurotransmitters. Dividing them into amino acids, peptides, and monoamines is sufficient for some classification purposes. The examples of amino acid neurotranmitters are glutamate, aspartate, D-serine, α-aminobutyric acid (GABA), glycine and that of Monoamines and other biogenic amines are dopamine (DA), norepinephrine (noradrenaline; NE, NA), epinephrine (adrenaline) amd histamine andserotonin (SE, 5-HT). The others are acetylcholine (ACh) adenosine, and anandamide.

In 1977, Dr. Ferid Murad of the University of Texas at Houston observed that some drugs, such as Nitroglycerin, causes the release of Nitric oxide (NO) in the body. Three years later, Furchgott's (State University of New York) work indicated that Acetylcholine and several other hormones caused the release of a molecule that make blood vessels dilate (become more open). Then in 1986 Louis J. Ignarro (UCLA) contributed the final puzzle piece that the mystery molecule doing the signaling was indeed Nitric oxide. Three of them shared the 1998 Nobel Prize in Medicine for their work on "Nitric oxide as a signaling molecule in the cardiovascular system". This was the first gaseous neurotransmitter ever discovered. Later Carbon monoxide (CO), an oxide of carbon also proved to be a good neurotransmitter. Nitric oxide is a diatomic free radical consisting of one atom of nitrogen and one atom of oxygen. It is soluble in lipids and is very small aiding for easy passage between cell membranes. It is short lived, usually degraded or reacted within a few seconds. In our body, Nitric oxide is synthesized from L-arginine. This reaction is catalyzed by Nitric oxide synthase (NOS). A schematic representation of the production of NO in the presence of NOS enzyme is shown below.



Nitric oxide functions as a signaling molecule that tells the body to make blood vessels relax and widen. This physiological reaction is important when the body needs more blood - the brain signals to the blood vessels near the arms, for example, when the arms need more blood supply for muscle movement or for warmth. Thus NO works as a signaling molecule in the cardiovascular system, the nervous system

and in other tissues. It regulates the binding and release of oxygen to hemoglobin and thereby controls the supply of oxygen to mitochondria (cell powerhouses that generate energy). It kills parasitic organisms, virus-infected cells, and tumor cells (by inactivating respiratory chain enzymes in their mitochondria). It stimulates the production of new mitochondria. Johns Hopkins scientists investigating Nitric oxide - the molecular messenger that contributes to body functions as wide-ranging as cell death, new blood vessel growth and erections - have figured out how it can block blood vessel inflammation and prevent clotting.

Besides these facts, it has been proved that Nitric oxide controls our blood pressure. It also helps in digestion by the virtue of its property to control its blood flow as and when needed by an organ of our body. Research from the Medical Research Council (MRC) Toxicology Unit at the University of Leicester shows that Nitric oxide can change the computational ability of the brain. This finding has implications for the treatment of neurodegenerative diseases such as Alzheimer's disease and our understanding of brain functions in general.

Nitric oxide has also proved its merit in other areas of medicines. Many drugs are capable of killing tumor cells. In this process, these drugs produce Nitric oxide in the drug metabolism and thus helps to destroy these tumors. Nitric oxide has been used for years in breathing gas as a way to relax blood vessels and maintains the blood flow in patients in hospitals. In battlefields, however, it might not be practical to carry gas tanks and ventilators to apply this therapy over a wide span of time. Nanoparticles were designed (at Albert Einstein College of Medicine of Yeshiva University in New York) to be loaded with Nitric oxide as a new way to provide a sustained therapy in such situations. Nitric oxide has found a vital position in Homeopathic medicines also. The research findings in the arena of Nitric oxide in medical fields are very vast and it is difficult to include all of them in this short review.

To conclude, NO has got a vital position as a neurotransmitter, a tumer killing agent, as a component in gas tanks and ventillators in dilating the blood vessels, in the treatment of Alzheimer's disease, in homeopathic fields etc. These are mentioned without completely overlooking its ill effects as a green house gas.

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Dr. S. Dileesh
Assistant Professor
Department of Chemistry
St. Peter's College
Kolenchery, Ernakulam, Kerala
E Mail: sdileesh@rediffmail.com

KALE: A WONDER LEAFY VEGETABLE

Dr. S.R. Singh, N. Ahmed, S. Lal, Saba Quarl and K.K. Srivastava

Kale is an important member of the Cole group of vegetable. The word Cole seems to have come from the abbreviation of the word "caulis" meaning stem and it was variously spelt as Kale (English), Kohl (German), Kool (Dutch), Kal (Scandinavian), Chou (French), Col (Spanish), Cavolo (Italian) and Couve (Portuguese) and the word "Cole" was generally more accepted in the literature. It means a group of highly differentiated plants originated from a single wild species of Brassica oleracea var. Oleracea (Sylvestris) commonly known as wild cabbage. Kale is an excellent source of traditional nutrients, including Vitamin A, Vitamin C and manganese. It is also a very good source of dietary fiber, calcium, copper, Vitamin B6, and potassium. This combination of vitamins, minerals, and phytonutrients makes Kale a health superstar

Kale is a leafy vegetable that is usually grouped into the "cooked greens" category with Collards, Mustard and Swiss Chard. The leaves can be curly or quite ornamental, but become too tough to eat fresh, as they mature. The beautiful leaves of the Kale plant provide an early flavor and more nutritional value for fewer calories than almost any other food around. Although it can be found in markets throughout the year, it is in the season from the middle of winter through the beginning of spring when it has a sweeter taste and is more widely available. It has gained recent widespread attention due to their health promoting sulfur containing phytonutrients. It is easy to grow and can grow in colder temperatures where a light frost will produce especially sweet Kale leaves. Kale is similar to other nutritional power houses, especially Cabbage relatives like Broccoli. However, it doesn't resemble Broccoli in appearance, having lovely dark green leaves instead of a miniature tree-like look. Kale has an earthy flavor that some people enjoy, but others find unappetizing. Due to its better nutritive value, cold hardiness, higher yield and good price in market, Kale is gaining popularity in India day by day. It is a widely grown leafy vegetable in Kashmir valley with an area of 2990 ha, 209300 tonnes production and 70 tonnes/ha productivity. Kale is brimming with antioxidants, such as Vitamin A, C and E, and helps in boosting the immune system of the body.

Kale germplasm at CITH, Srinagar

There are several varieties of Kale such as Curly Kale, Ornamental Kale and Dinosaur Kale, all of which differ in taste, texture and appearance. Curly Kale has ruffled leaves and a fibrous stalk and is usually deep green in colour. It has a lively pungent flavor with delicious peppery qualities. Ornamental Kale is a more recently cultivated species which is often referred to as Salad Savoy. It's leaves may either be green, white or purple and its stalk coalesces to form a loosely-knit head. It has a more mellow flavor and tender texture. Dinosaur Kale is the common name for Kale variety known as Lacinato. It features dark blur colour and green leaves that have an embossed texture. It has a slightly sweeter and more delicate taste than curly Kale.

Varieties classified on basis of different characters

1. On the basis of plant height: a. Dwarf varieties, b. Semi dwarf varieties and c. Tall varieties
2. On the basis of leaf character: a. Straight leaf varieties, b. Curled leaf varieties, c. Knol khol leaf type varieties.

Central Institute of Temporate Horticulture, Srinagar have more than 39 accessions/varieties of Kale. The major varieties are Khanyari Kale, Siberian Kale and Japanese Kale.

Nutritional value of Kale

- Kale is considered to be a highly nutritious vegetable with powerful

High Yielding Kale varieties from CITH, Srinagar

antioxidant and anti-inflammatory properties.

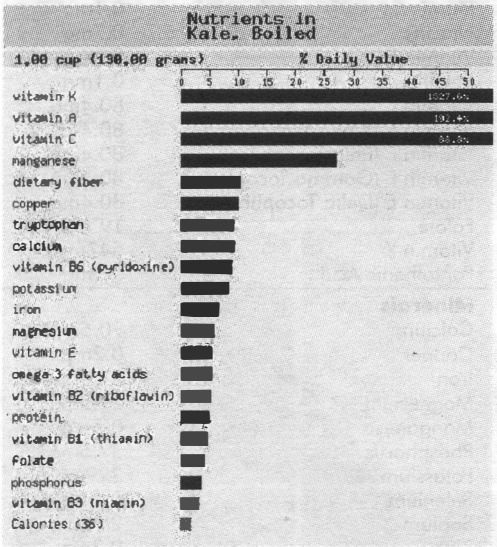
- Kale has seven times beta carotene than Broccoli and ten times more Lutein.
- Kale is well known for its carotenoids, especially Lutein and Zeaxanthin. These carotenoids act like sunglass filters and prevent damage to the eyes from excessive exposure to ultra violet light.
- It is an excellent source of Vitamin C which is the primary water soluble anti oxidant in the body, disarming free radicals and preventing damage in the aqueous environment both inside and outside the cells.
- It provides 10.4% of the daily value for fiber, which helps to reduce high cholesterol levels and prevent atherosclerosis.
- Kale is also extremely rich in Vitamin K which helps in blood clotting and helps to prevent post menopausal bone loss and protect against liver and prostrate cancer.
- It has an excellent quantity of Vitamin A which plays a part in eye health and prevents viral infections.
- Kale contains good amounts of manganese which helps the body to synthesize fatty acids and cholesterol. Manganese also helps with blood sugar levels and promotes thyroid gland health.
- Kale contains a good amount of calcium which is needed for strong bones and also helps with nerve and muscle function. Calcium also helps with blood clotting.

Table 1- Nutritional status of Kale per 67 g

Nutrients	Amount
Basic Components	
Protein	2.2g
Carbohydrates	6.7g
Water	56.6g
Ash	1.0g
Calories	
Total Calories	140KJ
Calories From Fat	16.3KJ
Calories From Carbohydrate	101KJ
Calories From Protein	22.6KJ
Carbohydrates	
Dietary fiber	1.3g
Starch	1.3g
Sugars	1.3g
Glucose	1.3g
Sucrose	1.3g
Fructose	1.3g
Lactose	1.3g
Maltose	1.3g
Galactose	1.3g
Fats	
Total Fat	0.5g
Saturated Fat	0.1g
Poly Fat	0.2g
Vitamins	
Vitamin A	10302 IU
Retinol Activity Equivalent	515mcg
Beta Carotene	6182mcg
Thiamin	0.1mg
Riboflavin	0.1mg
Niacin	0.7mg
Vitamin B6	0.2mg
Betaine	0.1mg
Vitamin C	80.4mg
Vitamin E (Alpha Tocopherol)	80.4mg
Vitamin E (Beta Tocopherol)	80.4mg
Vitamin E (Gamma Tocopherol)	80.4mg
Vitamin E (Delta Tocopherol)	80.4mg
Folate	19.4mcg
Vitamin K	547mcg
Pantothenic Acid	0.1mg
Minerals	
Calcium	90.5mg
Copper	0.2mg
Iron	1.1mg
Magnesium	22.8mg
Manganese	0.5mg
Phosphorus	37.5mg
Potassium	299mg
Selenium	0.6mg
Sodium	28.8mg
Zinc	0.3mg
Saturated Fats	
16:0 Palmitic	50.9mg
18:0 Stearic	2.7mg
Mono fats	
18:1 Oleic	32.8mg
Poly Fats	
18:2 Linoleic	92.4mg
18:3 Linolenic	121mg

Other fats	
Omega 3 fatty Acids	121mg
Omega 6 fatty Acids	92.4mg
Amino Acids	
Alanine	111mg
Arginine	123mg
Aspartate	198mg
Cystine	29.5mg
Glutamate	251mg
Glycine	107mg
Histidine	46.2mg
Isoleucine	132mg
Leucine	155mg
Lysine	132mg
Methionine	21.4mg
Phenylalanine	113mg
Proline	131mg
Serine	93.1mg
Threonine	98.5mg
Tryptophan	26.8mg
Tyrosine	78.4mg
Valine	121mg

This chart graphically details the percentage Daily Value (DV) that a serving of Kale provides for each of the nutrients of which it is a good, very good, or excellent source according to Food Rating System.



Medicinal value of Kale

"Icing on the Kale" are the natural occurrance of all important phytochemicals Sulforaphane and Indoles which may protect against cancer. Sulforaphane is formed when Kale are chopped or chewed which triggers the liver to produce the enzymes that detoxify cancer causing chemicals, of which we all are exposed on daily basis. Sulforaphane helps stop breast cancer cell proliferation. Kale is rich in a flavonoid called Kaempferol which causes a 40% reduction in risk of ovarian cancer, compared to women eating the least Kaempferol-rich foods.

Prevents heart disease

Consumption of Kale reduce the risk of a number of heart diseases. Phytonutrients found in this cruciferous vegetable, indole-3-carbinol, lowers liver cells' secretion of the cholesterol transporter, apolipoprotein B-100 (apoB) by 56%. Apolipoprotein B-100 is the main carrier of LDL cholesterol to tissues, and high levels have been linked to plaque formation in the blood vessels. When liver cells were treated with I-3-C, not only was apoB-100 secretion cut by more than half, but significant decreases also occurred in the synthesis of lipids (fats), including triglycerides and cholesterol esters.

Table 2 - Categorization of food rating on the basis of DV

World's Healthiest Foods Rating	Rule				
Excellent	DV>=75%	OR	Density>=7.6	AND	DV>=10%
Very good	DV>=50%	OR	Density>=3.4	AND	DV>=5%
Good	DV>=25%	OR	Density>=1.5	AND	DV>=2.5%

Prevents cancer

The organosulfur compounds in Kale that have been main subject of phytonutrient research includes the glucosinolates and the methyl cysteine sulfoxides. There is an ability of glucosinolates and cysteine sulfoxides to activate detoxifing enzymes in the liver that help neutralize potentially carcinogenic substances. These detoxifying enzymes include quinone reductases and glutathione-S-transferases. Sulforaphane, which is formed when Kale chopped or chewed, triggers the liver to produce enzymes that detoxify cancer-causing chemicals, inhibits chemically-induced breast cancers and induces colon cancer cells to commit suicide.

Protective against ovarian cancer

Kale is rich in a flavonoid called Kaempferol. In a Nurses Health Study on flavonoid intake in 66,940 women it was revealed that women whose diets provided the most Kaempferol had a 40% reduction in risk of ovarian cancer, compared to women eating the least Kaempferol-rich foods. In addition to Kale, foods richest in Kaempferol include non-herbal tea (like green tea), onions, broccoli, leeks, spinach, and blue berries.

Optimize cells' detoxification/ cleansing ability

The phytonutrients in crucifers, such as Kale, work at a much deeper level. These compounds actually signal our genes to increase production of enzymes involved in detoxification and the cleansing process through which our bodies eliminate harmful compounds. The phytonutrients in cruciferous vegetables initiate an intricate 'dance' inside our cells in which gene response elements direct and balance the 'steps' among dozens of detoxification enzyme partners, each performing its own protective role in 'perfect balance' with the other 'dancers'. The natural synergy that results optimizes the cells' ability to disarm and clear free radicals and toxins, including potential carcinogens. This way Kale appears to significantly lower our risk of cancer.

Lower cataract risk

In addition to its unique organosulfur compounds, Kale is well known for its carotenoids, especially lutein and zeaxanthin. These carotenoids act like sunglass filters and prevent damage to the eyes from excessive exposure to ultraviolet light. Studies have shown the protective effect of these nutrients against the risk of cataracts, where increased eye cloudiness leads to blurred vision. In one study it was seen that, people who had a diet history of eating lutein-rich foods like Kale had a 50% lower risk for new cataracts.

Kale also emerged from our food ranking system as an excellent source of traditional nutrients, including Vitamin A, Vitamin C, Vitamin B6 and manganese. It is also a very good source of dietary fiber, calcium, copper, and potassium. This combination of Vitamins, minerals, and phytonutrients makes Kale a health superstar!

Promotes lung health

Kale is rich in Vitamin A and studies proves the relationship between Vitamin A, lung inflammation and emphysema exists. A common carcinogen in cigarette smoke,

benzo(a)pyrene, induces Vitamin A deficiency and if a person takes Vitamin A-rich foods, such as Kale, it will save him from lung diseases.

Antioxidant protection and immune support

Kale is an excellent source of Vitamin C. Just one cup of this cooked vegetable supplies 88.8% of the daily dose of Vitamin C. Vitamin C is a primary water-soluble antioxidant in the body, disarming free radicals and preventing damage in the aqueous environment both inside and outside cells. Inside cells, a potential result of free radical damage to DNA is cancer. Especially in areas of the body where cellular turnover is rather rapid, such as the digestive system, preventing DNA mutations translates into preventing cancer. This is why a good intake of Vitamin C is associated with a reduced risk of colon cancer.

Free radicals also oxidize cholesterol. Only after being oxidized does cholesterol stick to artery walls, building up in plaques that may eventually grow large enough to impede or fully block blood flow or rupture to cause a heart attack or stroke. Since Vitamin C can neutralize free radicals, it can help prevent the oxidation of cholesterol. Vitamin C, which is also vital for the proper functioning of a healthy immune system, is good for preventing colds and may be helpful in preventing recurrent ear infections.

Manganese - Energy production plus antioxidant protection

Kale is rich in manganese mineral. This trace mineral helps produce energy from protein and carbohydrates and is involved in the synthesis of fatty acids that are important for a healthy nervous system and in the production of cholesterol that is used by the body to produce sex hormones. Manganese is also a critical component of an important antioxidant enzyme called superoxide dismutase. Superoxide dismutase is found exclusively inside the body's mitochondria (the oxygen-based energy factories inside most of our cells) where it provides protection against damage from the free radicals produced during energy production.

Source of fiber

Kale's health benefits continue with its fiber; a cup of Kale provides 10.4% of the daily value for fiber, which has been shown to reduce high cholesterol levels thus helping to prevent atherosclerosis. Fiber can also help out by keeping blood sugar levels under control, so Kale is an excellent vegetable for people with diabetes. Kale's fiber binds to cancer-causing chemicals, keeping them away from the cells lining the colon, providing yet another line of protection from colon cancer.

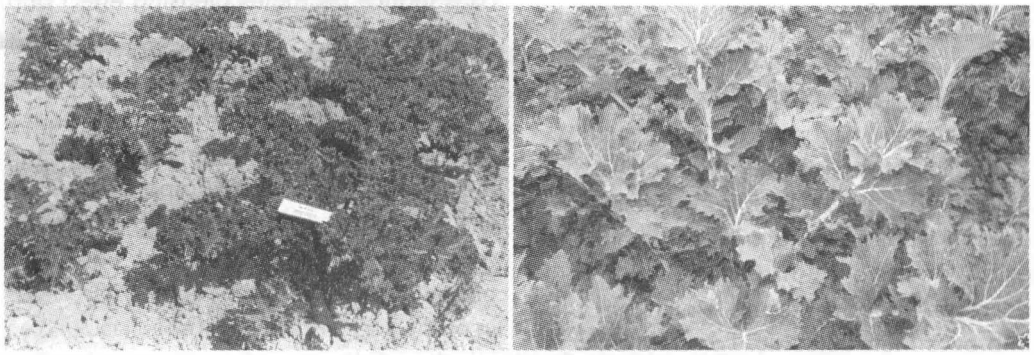
Slow loss of mental function

Mental performance normally declines with age; eating just 1 servings/day of Kale could slow this decline by 40%.

Culinary uses

Kale is used to make a stew of minced boiled Kale, stock, cream, pepper and salt that is simmered together slowly for a few hours. In Scotland, Kale provided such a base for a traditional diet that the word in dialect Scots is synonymous with food. To

Varieties suitable for culinary purposes



Ornamental Kale varieties

be "off one's Kail" is to feel too ill to eat. In some places collards, locally known as 'rashtan' is a favorite vegetable. It is particularly popular in winter, cooked with smoked mutton (Kastradina) and potatoes especially in Kashmir valley.

Decorative uses

Many varieties of Kale are referred to as "Flowering Kales" and are grown mainly for their ornamental leaves, which are brilliant white, red, pink, lavender, blue or violet in the interior or the rosette. Most plants sold as "ornamental cabbage" are in fact Kales. Ornamental Kale is as edible as any other variety, provided it has not been treated with pesticides or other harmful chemicals

Dr. S.R. Singh, N. Ahmed, S. Lal, Saba Quari and K.K. Srivastava
Central Institute of Temperate Horticulture
Old Air Field
P.O. Rangreth -190 007
Srinagar, Jammu & Kashmir
E Mail: srajparmar@gmail.com

Music Fights Stress

Dr. T.V. Sairam

"One good thing about music, when it hits you, you feel no pain."- Bob Marley

The number of patients opting for music therapy – in addition to the conventional medical intervention – is increasing day by day.

A popular Sunday morning interview with an estimated five million viewers was aired recently on the day-to-day work of a music therapist, Glen Schifano. Glen who works at a Long Island children's hospital encounters a variety of situations which include a typical day pre- and post-surgical visits, parent-child facilitated interaction, premature infant intervention, outpatient visits, etc.

In the interview, Dr. Mark Atlas, Head of the hospital had noted that the children in transplant tend to have difficulties with high blood pressure, both from medications and from pain. Relaxation, enjoyment and good positive mental state can help decrease blood pressure which actually improves their outcome. For children and their parents in an acute care hospital setting Glenn was quoted to say, "I try to keep the child in here and now and be there for the family, musically and emotionally."

The story also explained that even therapists make use of music to assist in handling their personal stress responses.

How doe Music address Stress?

One possible explanation for the relaxing effect in music appears to lie on its characteristics. Music we all know is continuous and rhythmical. In a natural environment, threat or danger is perceived to be accompanied by drastic and sudden, unexpected sounds. A background of constant sound, on the other hand – if continuous and regular or rhythmical - suggests peaceful conditions. A continuous sound, particularly one that is pre-judged to be safe tends to eliminate all possible threat perceptions from the mindscape. Concord creates continuity because the notes typically have overtones or harmonies that will match the next notes in an audible way. By tying such notes in a relationship, consonance promotes pleasing effect and relaxation.

As regards rhythms in music, there is an automatic synchronization of our body rhythms as they help us mentally organizing the sound. What is more important here is the comfort we derive from such organizations. The comfort could be attributed to the non-threatening assertions in music which not only consoles us but also inject confidence and sunshine, when we are down and depressed. For DeCasper and Sigafoos (1983), musical rhythms recall the pulse of the mother's heart imprinted pre-natally. In this context, it is relevant to note that discontinuous sounds, even if they are soft and in low decibels (For instance, as we hear when the leaky tap drips) can disturb and frustrate us greatly. They can cause sleeplessness and fatigue.

Dr. T.V. Sairam
F/48 B, Hari Nagar
New Delhi - 110 064
E Mail: tvsairam@gmail.com

SCIENCE INDIA QUIZ

Send the correct answers to Science India office or to arsmenon@gmail.com/scienceindia2010@gmail.com latest by 20th January, 2012. A science book as prize awaits you. If there are more than one correct entries, the winner will be selected by draw of lots

- Editor

SCIENCE INDIA QUIZ NO. 26

1. In the process of galvanization an iron sheet is coated with -------
2. The other name of baking soda
3. An organism which has no blood but respires
4. The function of haemoglobin is -------
5. Every atom has a tendency to become stable by -------
6. Rickets is a disease of the -------
7. The lowest layer of atmosphere
8. Some scientists believe that the extinction of dinosaurs is due to a comet fall on earth about 6.5 crores years ago. The profounder of this theory is -------
9. Alloy of Cooper + Tin
10. Name of the instrument that measures the radiation exposure that a person has gone through

Answers to Quiz No. 25

1. Ultrasonic waves 2. White phosporus 3. Mammalia 4. Iron 5. Butane & Propane 6. Tetanus 7. 40,000 km 8. Adrenal gland 9. Bell 10. Dermatoglyphics

The winner is Kum J. Resmi, Sri Durga Higher Secondary School, Kanhangad, Kasaragod. CONGRATULATIONS !!!

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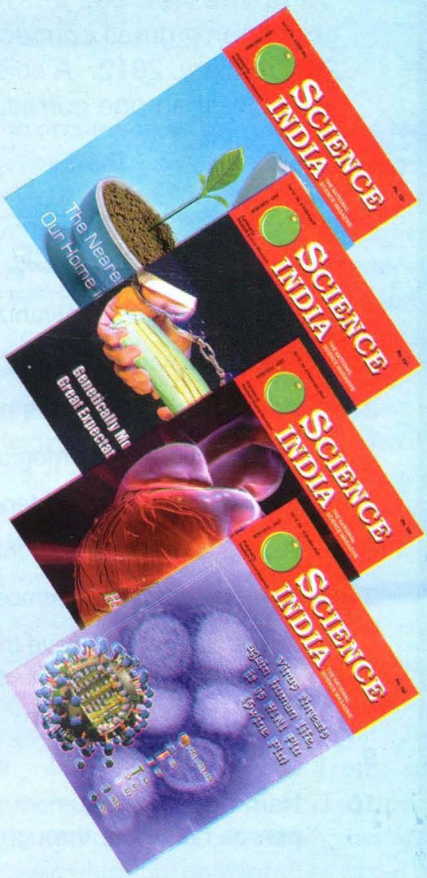

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